THE ORIGINAL MAGAZINE FOR MODEL ENGINEERS

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MODEL ENGINEER

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CON400 (110V)	16"	7200m³/hr	£319.00	£382.80
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IN THIS ISSUE

Vol. 229 No. 4697 12 - 25 August 2022

ON THE COVER...

Billy Stock sets out on his run at Guildford to win IMLEC for the second year running (photo: Andrew Neish).

This issue was published on August 12, 2022. The next will be on sale on August 26, 2022.

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Designed by Sir Henry Fowler for the London, Midland and Scottish Railway they were based on earlier designs by S&W. Johnson.

Some of the locomotives were loaned to the War Department in WWII, providing welcome logistical support to the allied war effort.

A majority of locomotives enjoyed long service with the final "Jinty" withdrawn in 1967, right at the end of the steam era. The locomotives were always painted in un-lined black livery. Before nationalisation in 1948 LMS initials were carried on the tank sides. In BR service either lion crest was carried according to period.

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- Etched brass body with rivet detail
- Two safety valves
- Choice of emblems
- Painted and ready-to-run
- Coal-fired live steam
- 5" gauge
- 2 inside cylinders
- Slide valves
- Stephenson valve gear
- Drain cocks
- Mechanical Lubricator
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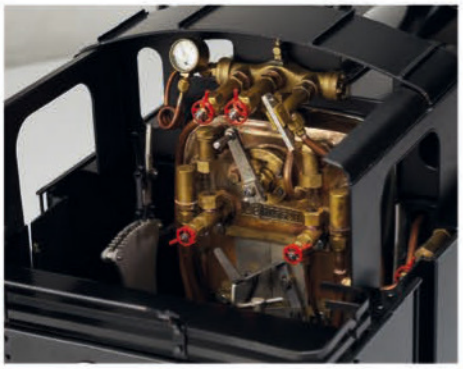
Each is complete with a silver soldered copper boiler, hydraulically tested to twice working pressure. All boilers comply with the latest regulations and are appropriately marked and certificated. The locomotive's compact size makes this an ideal model to display, transport and drive. As testament to our confidence in the high quality of this model we are pleased to offer a full 2 years warranty. Our customer service is considered to be second-to-none.

The "Jinty" is a powerful locomotive for its size and can negotiate tight curves, making it ideal for a garden railway. It incorporates our latest technical improvements including mechanically operated drain cocks.
As an award winning professional model maker I am delighted to have been involved in the development of this first class live steam locomotive"

Mike Pavie



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Designer

Martin Evans can be contacted on the mobile number or email below and would be delighted to receive your contributions, in the form of items of correspondence, comment or articles.
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ESSMEE Rally

The East Somerset Society of Model & Experimental Engineers (ESSMEE) will be holding a Model Engineers' Open Weekend at the Bath & West Showground near Shepton Mallet on September 24/25 this year. Visitors are invited to share our passion for our hobby in congenial surroundings on our ½ mile 5 and 7¼ inch gauge track, shunting yards for the smaller gauge, and the extensive tarmac network for steam road vehicles. This event will be for booked visitors only, with no public running.

There is ample space for campers and caravaners who want to stay for the whole event, with all essential facilities including electricity hook-up. Refreshments will be available throughout the day, and a barbecue on the Saturday evening.

For further details and booking forms, contact Michael Malleson on 01747 860719 or openweekend@essmee.org.uk

Oddity

I have had an avalanche of replies to my challenge to identify the latest 'oddity'! It looked like it may be some kind of tool but, in fact, it is a padlock, of the type found on carved camphorwood chests imported from the Far East. I feel slightly foolish as I should have recognised this device, being in possession of one of these chests. To be fair to myself, though, mine is missing its padlock.

I have had so many replies to this query that it is not possible to list you all. My apologies, gentlemen – fame will have to wait!

The Martin Evans (MkI) trophy is handed to Billy Stock by your editor, Martin Evans (MkII). (Photo: Andrew Neish)

Billy Does It Again!

This year's IMLEC (International Model Locomotive Efficiency Competition) took place at the Guildford MES track at Stoke Park on the weekend of July 22-24. Our reporter for the event is Guildford's Dave Tompkins, the first part of whose report may be found on the next page. The rest will follow next time.

I had the pleasure of attending on the Sunday and enjoying the glorious weather. The track was rather tricky, for various reasons, and provided a real test of skill for the competitors. The winner, by a clear margin, with an efficiency of 1.8%, was Billy Stock from Urmston, driving his 5 inch gauge 'Britannia' *William Wordsworth*. Billy also won last year's IMLEC at Maidstone, driving the same locomotive. Congratulations, Billy, on your double win!

Second place was taken by Steve Eaton, driving his 5 inch gauge German DB 2-8-0 and in third place was Ben Pavier with his 5 inch gauge LNER Q5. The 3½ inch gauge class was won by Les Pritchard, driving his LBSC 'Mona' locomotive. This locomotive, which is almost half a century old, has previously been a frequent competitor in LittleLEC.

A full list of results will be included in the second part of Dave's report.

Another Oddity

Something completely different... And something else to ponder while you bask in the sun. I am rather intrigued by this instrument. I suppose it is either nautical or aeronautical but why does it only read up to 60 degrees on the port side but all the way up to 180 degrees for starboard? This asymmetry must surely provide some kind of clue.

David Tompkins reports from this year's International Miniature Locomotive Efficiency Competition at the Guildford society's track in Stoke Park.

Nick Jackson - 5 inch gauge 'Speedy'.

IMLEC 2022 PART 1

IMLEC came to the Guildford club this year and with 25 entries was held over the weekend of July 22-24, just missing the heat wave. This was a relief to most of us at our club and in fact for a while it looked like it might even rain. It did however stay dry and it was ideal weather for playing trains. In the previous two weeks the club had completely cleaned its 1450 feet of raised track to give the competitors the best rail surface for their runs and we even closed the track to our club members so the track could be kept squeaky clean for the event.

It was rather disappointing that the track soon became greasy again and on Friday just about every locomotive was slipping with most having to set back and offload some passengers in order to get at least the first lap complete and give the locomotive enough momentum to carry on.

Tom Parham - 5 inch gauge Peppercorn A1 Tornado.

Friday

The first run, which was at midday was by Bracknell club member Nick Jackson driving a 5 inch gauge 'Speedy'.
He said he had bought the locomotive which had been in his club for years, having been built in 1979. He also mentioned that he was really a 7¼ inch gauge man but felt IMLEC could be fun to enter, at least for the first time, and he said his spirits were high. The same could not be said for the water level that he said was often low! Moving off with a load of six the locomotive was soon slipping and only just getting round at a slow pace and that with the safety valves lifting. This was followed by the train coming to a stop on a gradient. He managed to get on the move again but had to retire after 28 minutes, not making it to the finishing line.

Tom Parham was run number 2 and afterwards when asked how his run went he said "Fiddlesticks". This locomotive was really lovely - a 5 inch gauge *Tornado* built by Edgar Playfoot. Tom said it runs regularly at his Maidstone club, which was surprising given its immaculate condition - it looked almost new. Driven by Tom just a few times before IMLEC, the locomotive got off to a slippery slow start - a sign of things to come for the rest of the day. During his run Tom had a phone call from DHL saying they had a parcel for him - can they deliver? Well yes, they could have come to IMLEC with it! The locomotive ≫

continued on a steady pace and finished top of the table at the end of play for the day.

Next was Dave Shepheard with a Polly kit he had put together. It ran quite well at Maidstone last year but this year - oh dear! From the start it was slipping badly, setting backwards, still slipping and then being stopped as the track had not been set and he was wrong routed to go back into the steaming bay. Let's start again! At this point it was decided to move the start line a few yards further on so that one of the passenger trolleys wasn't actually on a down gradient at the start. Still the wheels were going round at a good pace but unfortunately the locomotive was hardly moving. Offloading passengers helped to get the wheels to grip the track but only one lap was managed before a retirement. Everyone in Dave's party said the locomotive runs well at his home track at Bracknell and I have no reason to doubt it - the track seemed to be getting greasier.

Next up was the first 3½ inch gauge locomotive, driven by Les Pritchard, a 'Mona' to the LBSC design. With a load of just three, which included grandson Archie, Les had a steady run and, like a lot of IMLEC drivers, Les was convinced that he put too much coal on. It's the first locomotive to compete at both LittleLEC, which it has won, and IMLEC itself so that can go in the record books! It was built by Alan Hall 'years ago' and still runs well, only stopping once on the run and that was for a dynamometer car derailment.

The next locomotive, driven by Danny Hayward, was quite an interesting freelance design by a chap by the name R. C. Marshall and built in 1944. It was freelance but you could see the LBSC influences in the design, particularly with the Baker valve gear. Finished in maroon and with nameplates *Mustang* and with its eight driving wheels it looked an impressive 3½ inch gauge locomotive. It had been recently bought and I'm told it had five test runs, three of which were 'brilliant'. But again, it was another run plagued by slipping and needed just a light load to get round the track.

Next up was the Guildford club entry, a 5 inch gauge B1 to the Martin Evans design driven by Matt Butler. Its construction was started by Paul Wheatcroft who unfortunately had a stroke and couldn't finish the locomotive, which he had taken to a well-advanced chassis. The Tompkins family took on the project with Paul making the boiler. Again, slipping was a problem. Passengers were offloaded and the locomotive set back to some level track. Now time was lost as the dynamometer car derailed again - perhaps it doesn't like going backwards. Once on the run, and with a lighter load to cope with low track adhesion, Matt had the locomotive running fine, well notched up. Injectors were working well and there was not much need to use the shovel but a light load meant a low figure of efficiency.

So now it was the turn of the last run of the day, a Nigel Gresley design by Martin Evans. This was a heavy locomotive with eight driving wheels and was expecting to do well but again poor adhesion due to the condition of the track required a really light load for what is a powerful design of locomotive. Driver John Williams was soon having to offload passengers and set back. And set back he did, way, way back until he

David Shepheard - 5 inch gauge Polly 5.

Les Pritchard – 3½ inch gauge 'Mona'.

Danny Hayward - 3½ inch gauge 2-8-2 Mustang.

MattButler - 5 inch gauge LNER B1.

John Williams - 5 inch gauge Gresley 2-8-0.

Glen Davies - 5 inch gauge 'Simplex' Janine.

Robert Hurst - 5 inch gauge S&D 7F.

Simon Batten - 5 inch gauge 0-6-0ST Jack.

came to a falling gradient and he set off at top speed until he came to the rising gradient - and again more slipping. John continued his run with spasmodic bouts of slipping and a light load.

That was the end of the runs for Friday and the start of some head scratching about what to do about the track with all the slipping.

Saturday

Saturday was a much earlier start, at 9.30am.

Glen Davies was the first to run with his 'Simplex'. It was his first run at an IMLEC with the first locomotive he has made and was a joy to watch. The locomotive spent most of the time flying around the track with its load of five in total. Half way into the run there was a loss of about five minutes caused by a passenger trolley derailment. Glen opted to have the lighter trolleys used only by club members rather than the heavier duty trolleys used for public days - a smart move but it has to be considered that the heavier trolleys do require more work done by the draw bar. The locomotive ran entirely on the axle pump managing to overfill the boiler once. Back in the steaming bay it was noticed there were quite a few extra holes in the ash pan.

Seeing that the first locomotive of the day had a good run was some relief to the host club as on the previous day a lot of runs were affected by the greasy track. A little track cleaning had been done but it was thought it would be a bit unfair to the ones who had run on the Friday if we completely degreased the entire circuit and, besides, it would have taken too long, delaying the event.

It was Robert Hurst's turn next, with a fine example of the Martin Evans design known as the S&D 7F. It ran very well at last year's IMLEC at Maidstone and Robert's dad Ivan was hoping for better things this time round. The run had a bit of a slow start with the slide valves lifting to allow water to escape up the chimney. The load was seven in total and the train came to a stop after one and a half laps. The train set back down the track offloading one passenger - a quick blow up and then the locomotive got on its way to have a very good run.

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We now had the turn of a smaller locomotive and a rare one at that - a design by Don Young known as 'Jack'. The late Don Young was an excellent designer so it was no surprise that this particular model, driven by Simon Batten, had a good run. At the starting line Simon wasn't going to move off until he had full pressure with the safety valves lifting. That was a wise move as it got the run off to a good start and with a light load the locomotive was happily going round the track. I was

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wondering if there was any weight added as on every lap Simon was taking on another bottle of water to fill his saddle tank. For one of the smaller locomotives in the competition it performed very well.

So we now came to a 'Star Turn', if I may call it that, a Nigel Gresley A4 built and run by Roger Holland who, as an apprentice, was familiar with the full-size article. I have to say that if you can make one of these things you are not doing too badly! The programme notes said the driver can be a bit of a problem but not the locomotive. With a load of nine in total, the run got off to a smooth start. It seemed that for the first fifteen minutes the driver just sat back and watched his well notched up locomotive going round as if it was its own master. That might have been overdoing things as a few minutes later the needle started to go south falling to about 20psi. Time was lost having a blow up before setting well back. For about the next ten minutes the locomotive was trying to get up the curved incline before setting further back and dropping a passenger. A rather disappointing end to a rather good start.

Lilla, a Hunslet 3½ inch gauge locomotive, entered the ring for the next round. The driver was George Winsall - and what would IMLEC be without the Winsall family? The locomotive means a lot to them as it was built by George's grandfather Fred but got sold off. Recently it came back on offer to his family and it was quickly snapped up. It can't be said that the run was trouble free. Quite a small and lightweight truck was used to act as a tender. The heavy dynamometer with its curling hook lifted the little truck off the track several times causing delays to a little locomotive that was running well. I understand there are plans to make a bigger stronger wagon for it to enter a future IMLEC.

It seemed that for the first fifteen minutes the driver just sat back and watched his well notched up locomotive going round as if it was its own master.

The next locomotive was something interesting, as it had actually been driven by Nigel Gresley, the real flesh and blood full size one, in 1937. That makes the model – *Spitfire*, a 5 inch gauge Gresley A1 driven by Andy Nash, quite the oldest one at this year's IMLEC, or any other IMLEC for that matter. As for the run – well, it wasn't exactly trouble free. The problem was with the fire grate design. It had hooks and pins to hold it in place for shovelling the coal and, on one particular shovelling, the driver managed to accidentally hook the grate sideways with the shovel, dropping the coal into the ash pan. Ah well, these things happen but best not when running at IMLEC.

And now another interesting runner, a 3½ inch gauge Southern Q1. I do believe that no locomotive can be called ugly, particularly if they're Southern - 'graceful' seems a better word to describe them. If anyone fancies building one the designer and its driver Nick Feast had the plans published

Roger Holland - 5 inch gauge Gresley A4 Wild Swan.

George Winsall - 3½ inch gauge Hunslet Lilla.

Andy Nash - 3½ inch gauge Gresley A1 Spitfire.

Nick Feast - 3½ inch gauge Southern Q1.

Tom Taylor - 3½ inch gauge Derby 4F.

Andy Healey - 5 inch gauge 'Britannia' Apollo.

Alan Crossfield - 5 inch gauge Ex LMS 'Patriot'.

Ben Pavier - 5 inch gauge LNER Q5.

in the *Model Engineer* in 2009. The run itself, and it was quite a short one, did have a few problems. Several stops with setting backs - wait for blow ups - have another go at getting up the incline with a very light load and probably thinking to enter another IMLEC somewhere else in future with a more level track. But it was a great looking engine.

While Nick Feast was having his run I noticed a very well cleaned up locomotive preparing for the next run. It was Tom Taylor's 3½ inch gauge Derby 4F. I think this is a brilliant design that I would recommend to anyone, particularly those with a modest workshop and not much experience in model engineering. And don't let anyone say the Joy valve gear isn't that good because I've seen too many that run well. I'm not sure if Tom has had much driving experience but he seemed a little apprehensive while raising steam. Worse was to come - I started giving him advice! I suspect the thought he took away from the experience was 'right, next time I enter it will be a lot better'.

So it's now late afternoon with just three more locomotives to run, the first being a 5 inch gauge 'Britannia', well known now as the work of Karl Midgley, who died suddenly on the morning of his scheduled run at the Maidstone IMLEC last year. Driven by his uncle Andy Healey with the locomotive painted in blue, because that's what Karl wanted, the run was fast without much fuss really. I can only say it was a very good run and one that Karl would approve of, even if he thought he could have done just a little bit better himself!

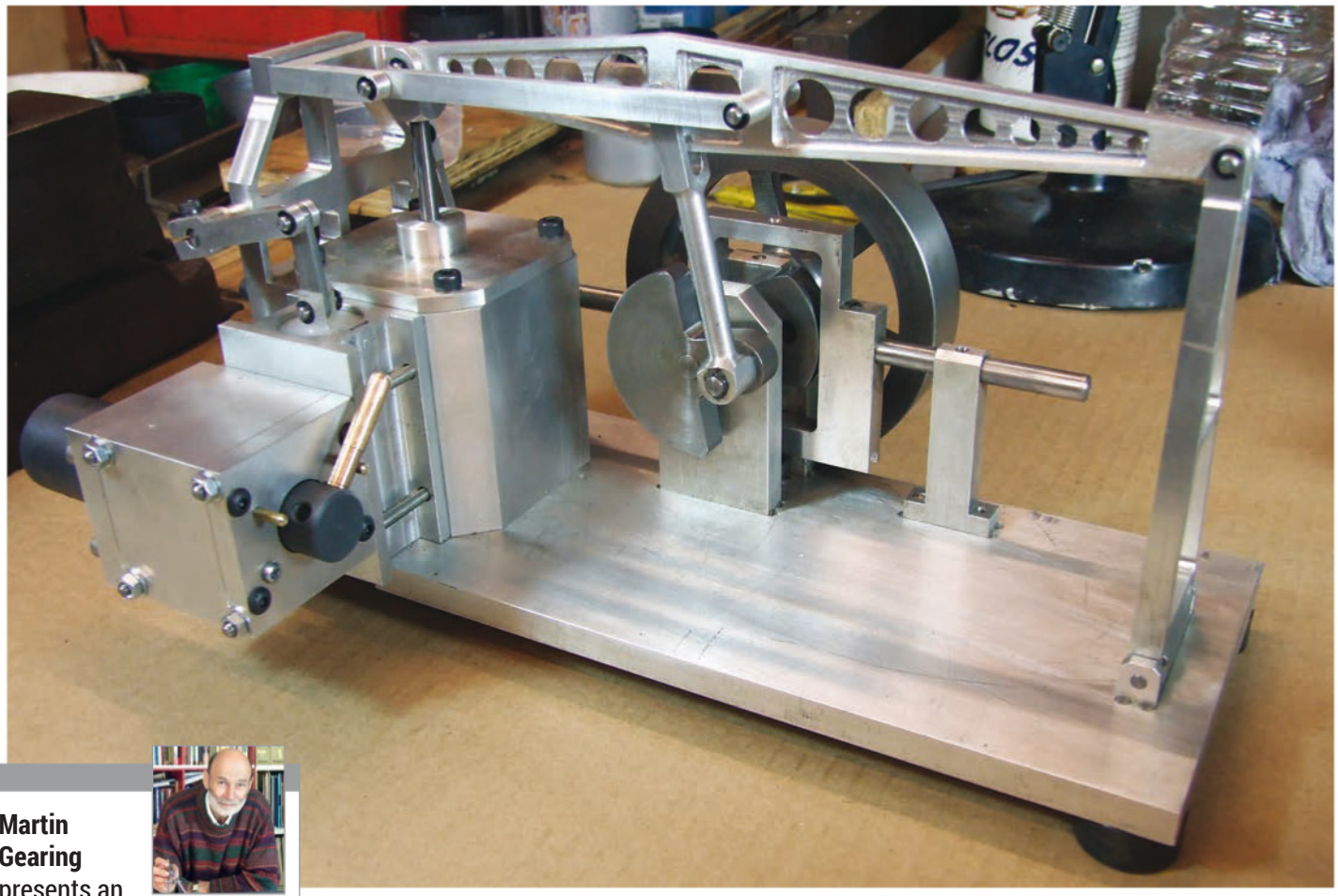
And so it was now the turn of what I can only describe as a first class model of the highest standard - a locomotive built by Alan Crossfield - the LMS class of locomotive known as the 'Patriots'. It's won this cup, that cup, every cup. Just for a laugh I asked Alan if the tender had the exact number of rivets as its full-size sister. Alan looked puzzled and just said 'well, yes'. The run itself, well forget it. Matters were not helped by a water pipe being wrongly connected tender to locomotive. Slipping on an oily track, setting back a few times until the locomotive found its feet better - it wasn't the best of runs. But still, a lot of people looking on were probably thinking how long did it take to make that one? and gosh! I wish I had one.

So it's time for the final run of the day by Ben Pavier, a seasoned campaigner at IMLECs and who knows how to play them. I have to say his observer made my day. He thought it was my 'Netta'! The run was nothing other than was expected, superb and trouble free with his mates as his load. Except, that is, for the last lap when Ben took a gamble with a low fire - pressure dropping and the water going down in its gauge. But the locomotive managed one last lap and its performance got it top of the leader board.

We are not youngsters at the Guildford club so we went home now to put our feet up and look forward to the final day tomorrow.

All photographs were taken by Andrew Neish.

●To be continued.



Martin Gearing presents an ideal beginner's project with great potential for the more experienced builder.

Grasshopper Beam Engine

Introduction

I created and made a larger version of this engine some 20 years ago as a training course final test piece and must confess to having only recently discovered that its true description is not that of a 'Grasshopper Beam Engine' (which perfectly describes its action) by which I've always known the design but should be referred to as a 'Half Beam Engine' invented in about 1795 and built commercially from 1801 by Oliver Evans, an American engineer (see *Model Engineer* vol. 187 No. 4156 p.324 for full details).

The version of my engine described here is primarily intended as a training project for beginners - to give experience - and assumes access to basic facilities. I have chosen metric dimensions because I refuse to pay the premium now demanded for Imperial tools and fixings and think a beginner starting out would appreciate this. People who still have an aversion to the metric system can change everything to Imperial by using a calculator, dividing everything by 25.4, going to the nearest size available and making the adjustments that will result.

Upon completion the constructor will experience the pleasure of making something that has visually one of the most interesting motions and enjoy experiencing the pride of having created a conversation piece by their own application and handiwork, enough I hope to want to make more. It is not based on any known prototype and is powered from a readily available if slightly unconventional source!

The materials chosen are intentionally a little unconventional and a mixture

of sizes but had to be easily available stock sizes at the lowest cost. Certain parts may be machined with alternative options (given in the text) to enhance the appearance but adding time to the engine's construction. It has also been possible to negotiate with a material supplier a 'One Stop Shop', which makes the whole fag of getting all the materials required very much easier - and with a discount.

When running, because all the motion work is visible, the design makes for a very interesting display and, because of the choice of valve gear, which I've taken from the type originally used on Mississippi stern wheel paddle steamers, it is able to run reliably very slowly on low pressure air in the form of a vacuum from a domestic vacuum cleaner.

Table 1. Materials required

Part #	Description	No Off	Material
1	Base	1	10mm x 12 inch square 5038 Ali Plate
2	Main Bearing Carrier	2	10mm 5038 Ali Plate – From 1
3	Cam Follower Bearing	2	10mm 5038 Ali Plate – From 1
4	End Link Pivot Block	1	10mm 5038 Ali Plate – From 1
5	Cam Follower Key	1	10 x 30mm Mild Steel/Brass
6	Main Bearing Bush	2	Ø19mm/¾ inch LG2
7	Cam Follower Shaft - Short	1	Ø8mm x 13 inch Silver Steel
8	Cam Follower Shaft - Long	1	Ø8mm Silver Steel – From 7
9	Cam Follower Frame	1	10mm 5038 Ali Plate – From 1
10	Crank Pin	1	Ø6mm x 13 inch Silver Steel
11	Crank Shaft	1	Ø8mm Silver Steel – From 7
12	Crank Web	1	Ø60mm x ½ inch EN1A
13	Valve Cam	1	Ø50mm x 1 inch Cast Iron
14	Flywheel	1	Ø120mm x 1¼ inch Cast Iron
15	Flywheel Collet	1	Ø40mm x 2 inch EN1A
16	Cylinder Block	1	3 x 3 x 3 inch 6082 Ali
17	Cylinder Cover	1	3 x 3 x 1 inch 6082 Ali
18	Piston Rod	1	Ø6mm Silver Steel – From 6
19	Piston	1	Ø70mm x 1 inch Acetal
20	Piston Rod Clevis	1	16 x 16mm / ⅝ x ⅝ x 12 inch 6082 Ali
21	Link Anchor Mount	1	10mm 5038 Ali Plate – From 1
22	Link Anchor	1	8mm x 6 inch square 5038 Ali Plate
23	Beam	1	30 x 6mm / 1¼ x ¼ x 12 inch 6082 Ali Flat
24	Control Link	2	8mm 5038 Ali Plate – From 22
25	End Link	1	8mm 5038 Ali Plate – From 22
26	Connecting Rod	1	12 x 12mm / ½ x ½ x 6 inch 6082 Ali
27	End Link/Pivot Block Pin	1	Ø4mm x 13 inch Silver Steel
28	End Link/Beam Pin	1	Ø4mm Silver Steel – From 27
29	Control Link/Beam Pin	1	Ø4mm Silver Steel - From 27
30	Control Link/Anchor Pin	2	Ø8mm Silver Steel – From 7
31	Connecting Rod/Beam Pin	1	Ø4mm Silver Steel - From 27
32	Piston Clevis/Beam Pin	1	Ø4mm Silver Steel - From 27
33	Valve Gear Cross Shaft	1	Ø6mm Silver Steel – From 10
34	Valve Lever – Cam	1	16 x 16mm / ⅝ x ⅝ inch 6082 Ali - From 20
35	Valve Lever Drive Pin	1	Ø6mm Silver Steel - From 10
36	Valve Lever – Spool	1	16 x 16mm / ⅝ x ⅝ inch 6082 Ali - From 20
37	Valve Block	1	2 x 2 x 3 inch 6082 Ali
38	Valve Spool	1	Ø30mm x 4 inch Acetal
39	Valve Link	1	10 x 3mm Mild Steel Flat
40	Valve Spool Link Pins	2	Ø4mm Silver Steel – From 27
41	Control Valve Body	1	2 x 2 x 2 inch 6082 Ali
42	Control Valve Spool	1	Ø40mm x 3½ inch Acetal
43	Control Valve Spool Retainer	1	2 x 2 x ½ inch 6082 Ali
44	Control Valve Handle	1	Ø6mm x 6 inch Brass
45	Control Valve Stop Pins	2	Ø3mm Brass - From 44
46	Vacuum Hose Adapter	1	Ø50mm x 2 inch Nylon 6/PVC
47	Vacuum Hose Adapter Retainer	1	2 x 2 x ½ inch 6082 Ali
48	Feet	4	Ø25mm x 12mm Nylon 6/PVC

Aimed at and written unashamedly for a beginner, I felt that it would be more attractive if there was a readily available form of motive force. The engine as designed will run on the vacuum provided by a domestic cleaner (or - if a compressor and suitable regulator are available – low pressure compressed air). This choice means there's no need to produce a boiler with its attendant cost, annual testing and requirement for being operated in a well-ventilated space.

Getting an engine of this size to run on the low pressure that a vacuum cleaner provides has demanded a large cylinder diameter and this has been limited by the maximum diameter the average beginner is able to machine. This however produces a major benefit in that the tolerances required to guarantee a running engine can be greater than for an engine that requires a magnifying glass to see!

Whilst the buzzwords for the moment are CNC, laser cutting and 3D printing the tools required for this project are conventional and, more importantly, readily available. To complete this project you will need basic hand tools including a means of marking out. A 150mm digital caliper would be essential and nice to have or be able to borrow would be:

* A 0 – 25mm (and 25 – 50mm if possible!) micrometer.
* Optical centre punch.
* Set of telescope gauges.
* Lathe of at least 90mm (3½ inch) swing, with a basic range of HS tooling.
* Small vertical mill with (if possible) X and Y axis DRO, and a bed stop on the X axis, with clamp kit.
* Small boring head.
* H/V rotary table, or rotary table and horizontal indexing device.
* Drilling machine Ø13mm preferred (Ø10mm capacity min.).
* Drills - Ø1 to 6mm in 0.1mm steps and Ø6 to Ø13mm in 0.5mm steps.

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Whilst the buzzwords for the moment are CNC, laser cutting and 3D printing the tools required for this project are conventional and, more importantly, readily available. To complete this project you will need basic hand tools including a means of marking out.

Table 2. Sundry items

Description	No Off	Material
Link Anchor Mount	4	M5 x 20 SHCS
Cylinder Cover	4	M5 x 15 SHCS
Valve Levers	4	M4 x 20 SHCS
Adaptor Retainer	4	M4 x 15 SHCS
Cylinder (Bottom) & Feet	8	M5 x 12 CS Hd
Main & Cam Bearings	8	M4 x 16 CS Hd
End Link Pivot Block	2	M4 x 13 CS Hd
Control Valve Retainer	4	M4 x 15 Round or Button Hd
Crank & Cam Frame	4	M5 x 10 Grubscrew
Valve Cam	1	M4 x 10 Grubscrew
Link Pivot Block	1	M3 x 10 Grubscrew
Piston Rod Securing Nut	1	M5 Nylock Nut
Piston Rod Securing Nut	1	M5 Plain Nut
Piston Rod Securing Plain Washer	2	Ø5mm Plain Washer
Valve Block Securing Nut	4	M4 Plain Nut
Valve Block Securing Washer	4	Ø4mm Plain Washer
Control & Engine Valve Blocks	4	Ø4mm x 95mm Studding
Control valve Spool Valve Rotation Damper	1	BS211 'O' Ring (1.074 x 0.796 x 0.139 inch)
'E' Clips	14	3.2mm x 0.69mm Spring 'E' Clips

* Taps and dies, covering the range M3 to M6.

Access to a band saw (jigsaw as a second choice) would be a great help but an alternative method for cutting the thicker plate work is given.

Although it would be possible to use a lathe only, the setting up would make it extremely hard/tedious for anyone other than a VERY dedicated/motivated constructor (and most likely destroy a beginner's motivation).

You or the person helping you will also need to have knowledge of basic mechanical engineering terminology and be able to make sense of two-dimensional drawings. I have included pictures that show all of the setups and drawings - breaking down the more complicated parts into 'bite sized chunks'! By relating the text with the drawings and pictures most of the unfamiliar terms will be self-explanatory. The original founding engineers described what they were creating using simple words they understood, and were familiar with, and created most of the terms we use today!

In an effort to assist beginners who are unfamiliar with the process of working to information contained in two dimensional drawings, I admit to having taken a large degree of 'poetic licence' when the drawings provided are compared to the accepted industry standards. My defence is simply that the drawings are merely a form of communication, and I have found that the 'quirks' used have helped to make the information less daunting for absolute beginners when I was teaching at the secondary level and was found to be usefully productive again when instructing adults. If you know enough to comment then you definitely should be able to work it out, whilst explaining your thinking to the person you should be mentoring!

Please understand that, for the more experienced, I can do no better than quote Edgar T. Westbury's words from page 89 of the July 23 1942 edition of *Model Engineer*: 'The methods which I recommend are always intended as a guide to the un-initiated, rather than an attempt to convert those with sufficient experience to be able to tackle these problems in their own way'. That having been said, the design was always primarily intended to provide experience and lends itself to being made as a project with a youngster/s, or - with additional details added - limited only by the maker's desires!

I am able to provide a suggested metal cutting list with the item description, material type and size (**table 1**) in addition to a list of the sundry items required (**table 2**). By way of trying to assist those starting out, Noggin End Metals – 01782-865428 (ask for the Grasshopper Metal Pack) - have agreed to make a metal pack available to cover the bulk of materials required, which will be found a great help if you are starting out and don't have 'preferred suppliers' or dad's workshop (to raid when he's not about) and gives value for money with the convenience of a 'one stop shop'. The mix of metric and Imperial dimensions as mentioned earlier has been brought about because I've tried to obtain the lowest cost from a single source. I'm sure there are few that find pleasure in going to 60 different suppliers for 60 different items, which would be extremely dispiriting for a beginner starting out with little or no stock materials.

Just a reminder, that before starting this project, where the use of a vertical milling machine is required, the head/spindle and vice should be checked for correct alignment to the machine table, something often forgotten and a frequent source of errors, and the spindle at standstill when any measurement or adjustment is being made.

●To be continued.

NEXT TIME

We make a start by cutting out the plate material.

PART 2

5 Inch Gauge Timber Frame Driver's Truck

David Allen makes extensive use of 3D CAD and laser cutting to make a timber framed driving truck.

Continued from p.223
M.E. 4696, 29 July 2022

Fig 11 Side frame (25 x 50mm planed hardwood Idigbo, 2 off).

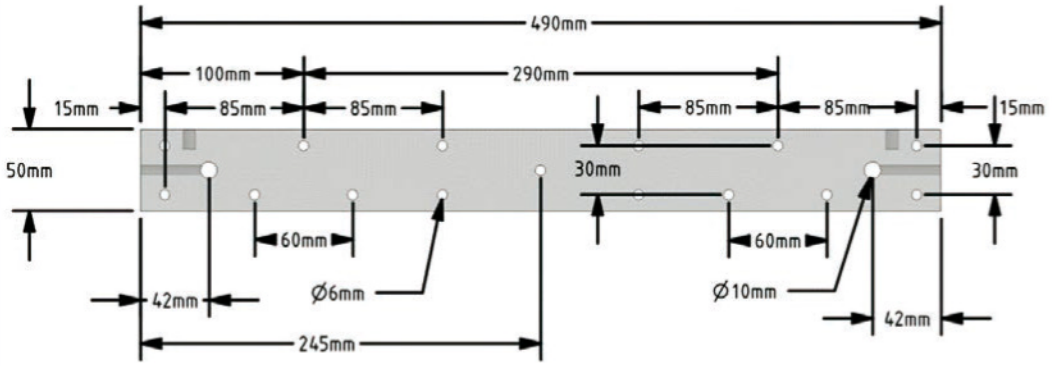
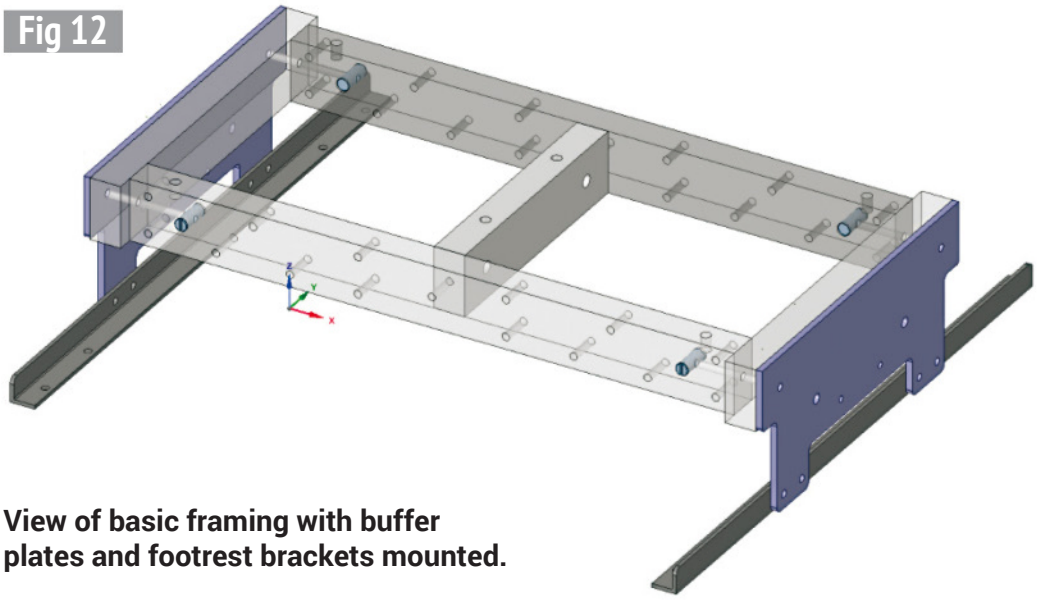
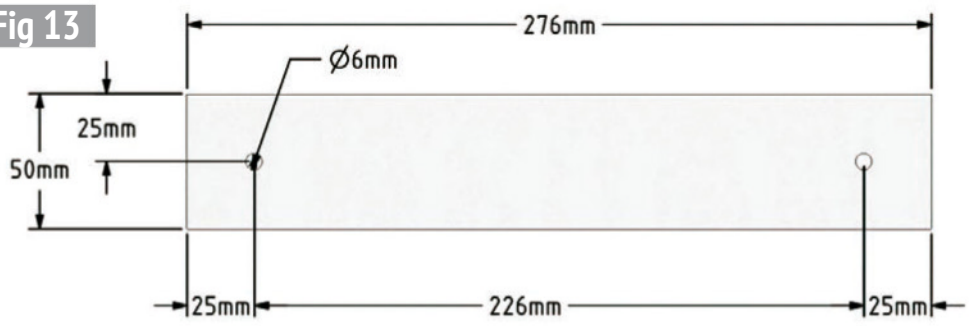


Fig 12



View of basic framing with buffer plates and footrest brackets mounted.

Fig 13



Headstock (25 x 50mm hardwood, 2 off).

Building the frames

The frames were cut from an African hardwood known as Idigbo and finished to 25 x 50mm (**figs 11** and **12**). My local timber merchant was very co-operative, supplying all hardwood cut to size including a Birch plywood base board for a very reasonable £38. It's best to get the timber cut slightly longer than the drawings and then square up in the mill with a very sharp cutter. Add an off-cut of the same material as packing so the cut does not lift the fibres of the wood at the edge/end of the cut.

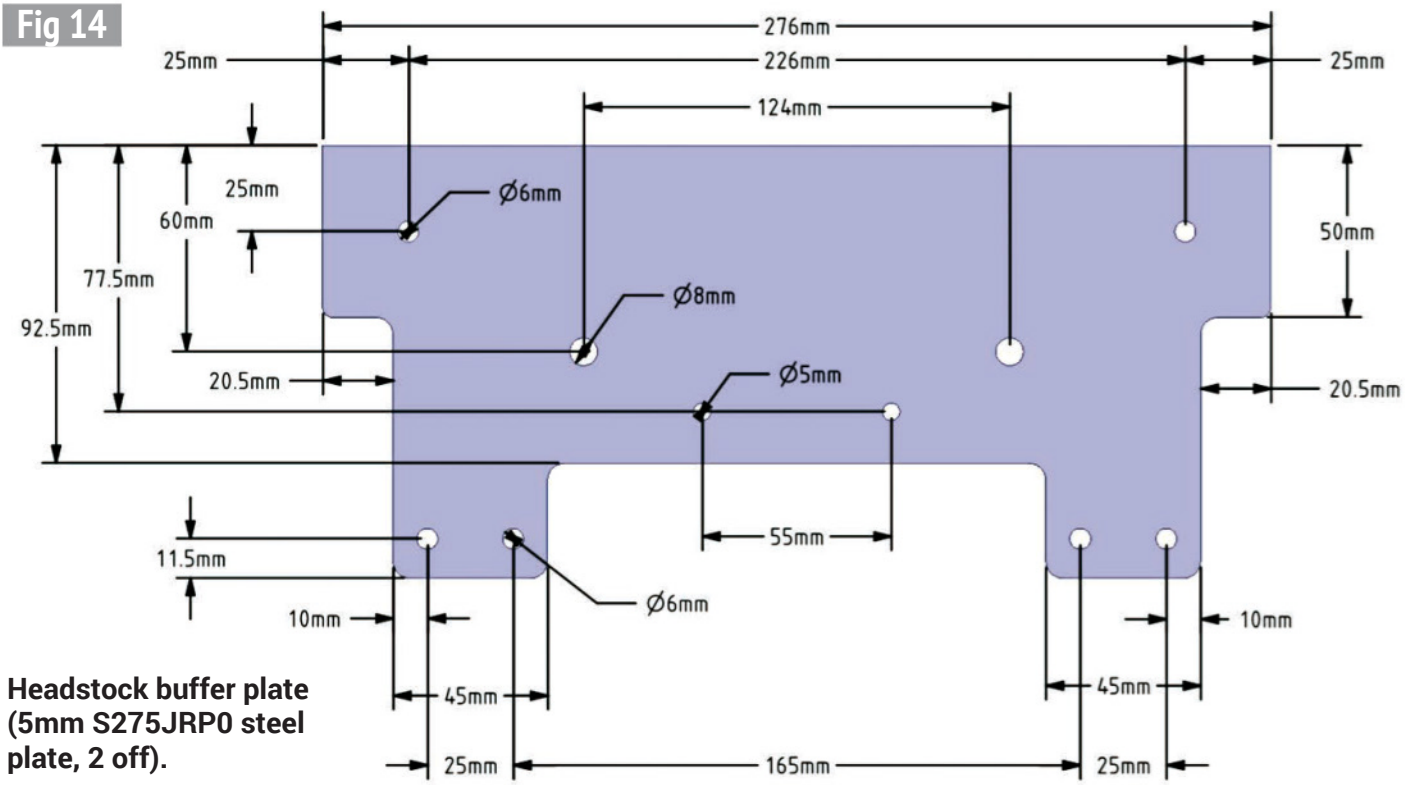
Note that Idigbo is slightly acidic to ferrous metals so best not to leave the shavings on the mill table overnight.

The headstock for the wagon (**fig 13**) comprises a similar cross section piece of hardwood together with a steel buffer plate designed to hold a footrest bracket and coupler. These are bolted onto the end of the side frames and held in place by dowel nuts. A middle stretcher is used to keep everything square. Dowel nuts used throughout this project are M6 at 10mm diameter x 25mm long, and six ≫

18+

WHAT IS AVAXHOME?

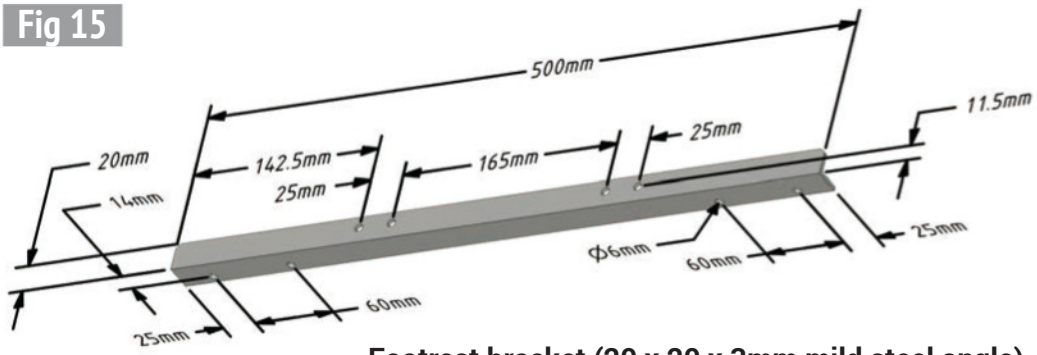
Fig 14



Headstock buffer plate (5mm S275JRP0 steel plate, 2 off).

Note that Idigbo is slightly acidic to ferrous metals so best not to leave the shavings on the mill table overnight.

Fig 15



Footrest bracket (20 x 20 x 3mm mild steel angle).

are required. They are listed on eBay and other online retailers.

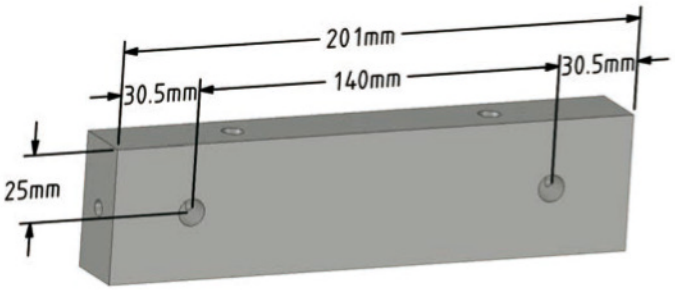
The headstock buffer plate is shown in **fig 14**. This was designed to support the footrest bracket (**fig 15**) and a coupler to hitch it up to the locomotive. Two holes on 55mm centres are provided for mounting a coupler. The two 8mm diameter holes are to locate 8mm eyebolts as safety features as there are no brakes in this design.

The middle stretcher shown in **fig 16** is from 25 x 50mm hardwood. The dowel nut bolt-hole can be seen at the end of the timber. It's advisable to jig these holes and try it out on a piece of scrap to ensure the hole is perfectly in line with the centreline of the dowel nut each time. This part is shown with two 8mm dowel holes cut in the top. These should be transferred from the baseboard.

With the basic framing now cut to size and drilled it's time to mount on the baseboard, first as a dry run to transfer the dowel pins and then finally to glue and clamp the whole assembly together.

18mm Birch ply was chosen for the baseboard (**fig 17**) so the sides are thick enough to support dowel plugs to secure side planking. With the headstock and buffer plates in place there should be a 12.5mm gap between the leading edge of the baseboard and front of the buffer plates. This space is for the front and rear side planking.

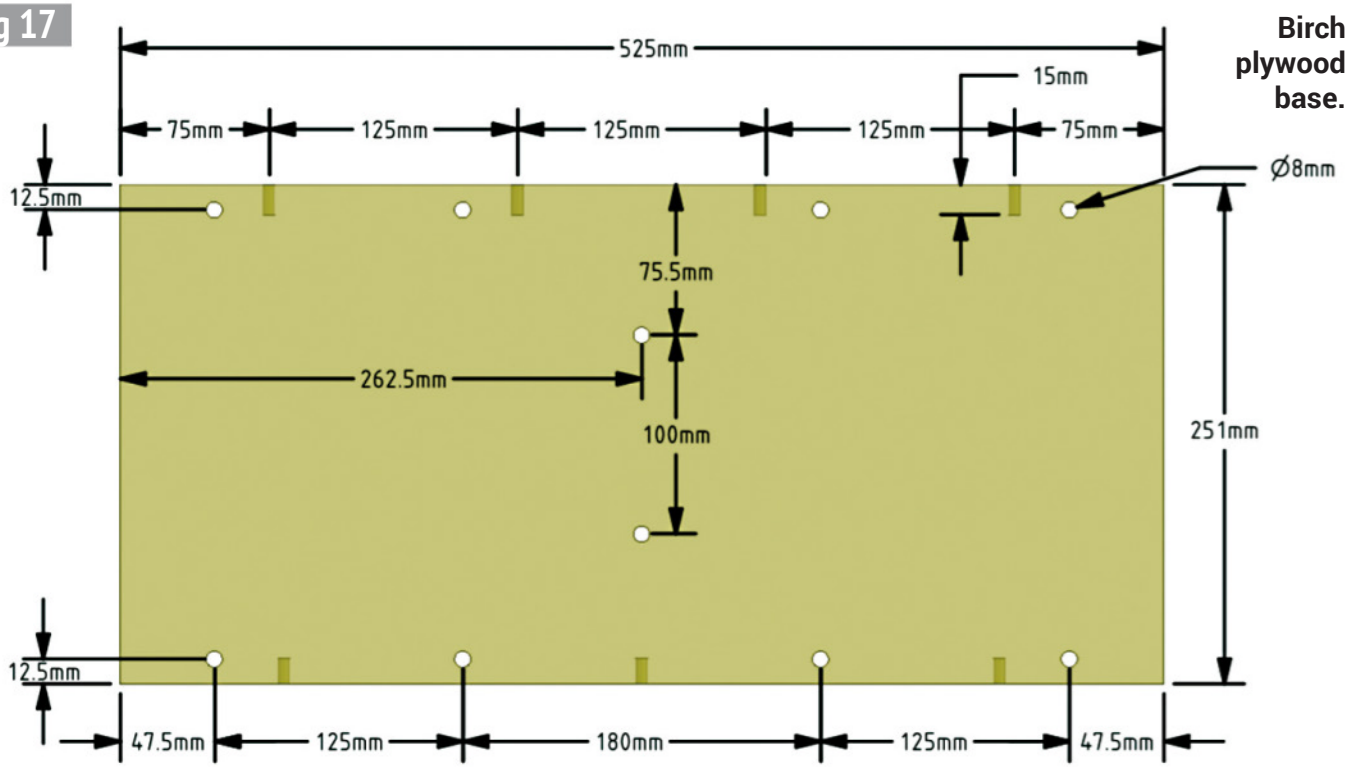
Fig 16



Middle stretcher (25 x 50mm planed hardwood Idigbo).

8mm dowels were used between the base board and the frame but a word of caution here; it's a good idea to try your dowel plugs in a piece of scrap material before you drill the parts. I found

Fig 17



that dowel plugs including wood drill bits vary between suppliers. Some gave a good, snug fit that tapped in with a light blow from a hammer, but I found that some suppliers' dowels were loose. Use fluted dowels as these allow the air and excess glue to be expelled when tapped into a blind hole.

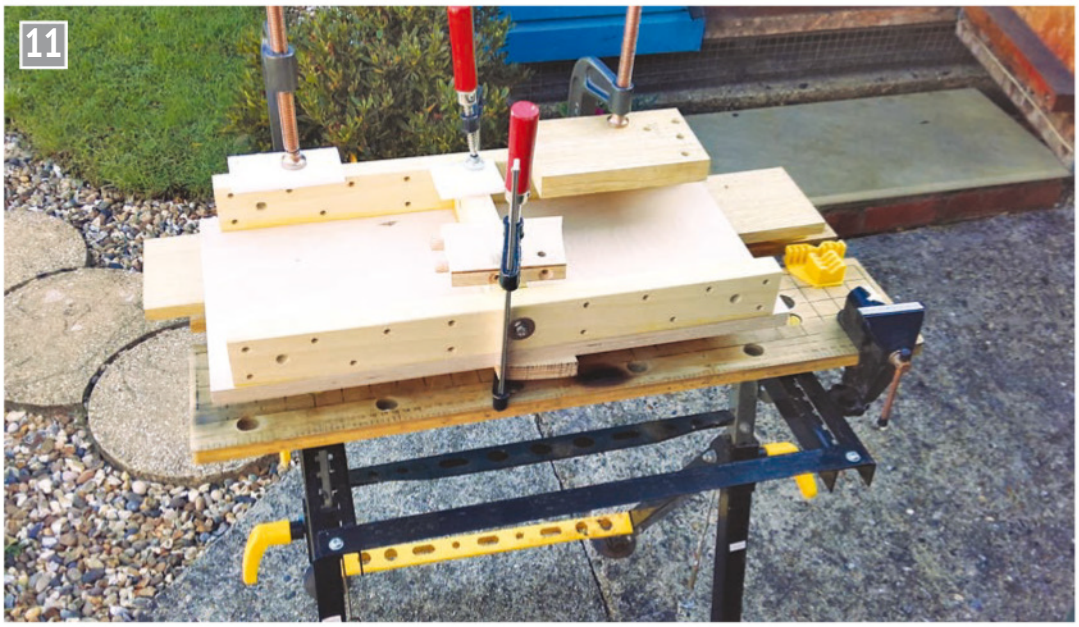
Once you're satisfied that a test piece is okay, transfer the holes from the baseboard to the frame and then dowel and glue the baseboard in position. Alternatively, you could use woodscrews. The position of the dowels was chosen so as not to clash with the axle W frames.

The dowel holes shown for the side planking are for 6 x 30mm dowels, drilled 15mm deep.

Photograph 11 shows the mid stretcher and one side all clamped up with bits of scrap material to protect the surface. Idigbo might be classed as a hardwood but can be easily damaged if care isn't taken.

Next time we will complete the driving truck by adding the side panels and seat.

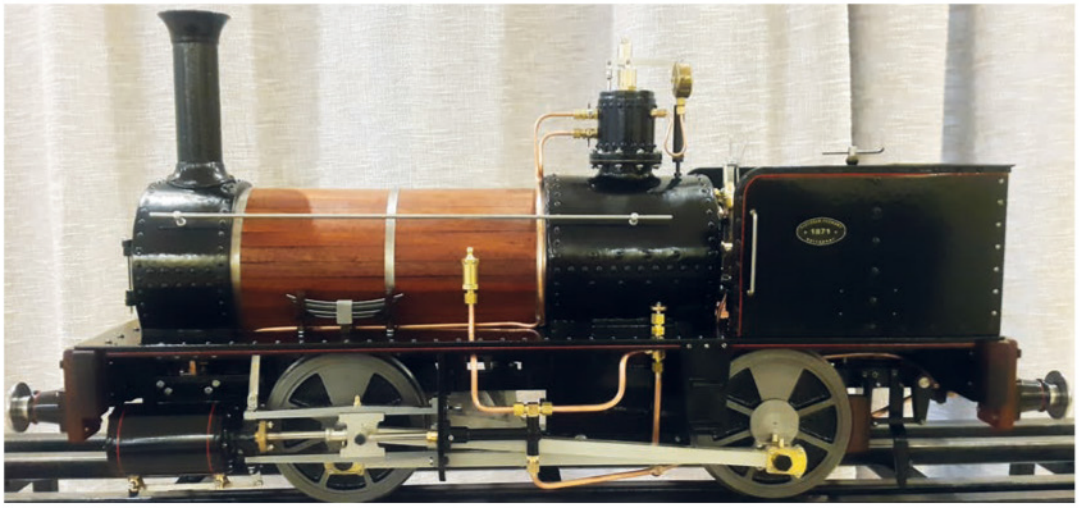
●To be continued.



Side frames and mid stretcher dowelled and glued.

Luker describes a simple but authentic small locomotive.

Continued from p.149
M.E. 4695, 15 July 2022



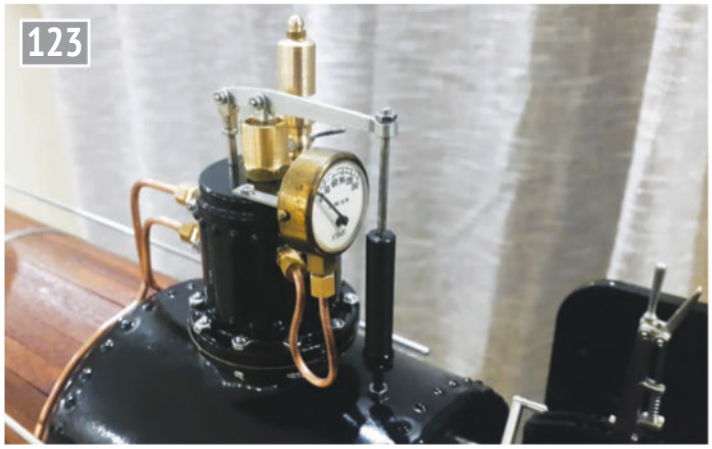
Ballaarat PART 15

A 5 Inch Gauge 0-4-0 Aussie Locomotive

Safety valve assembly

The prototype safety valve configuration was closely followed in the model (**photo 123**). It looks incredibly simple but that's where the simplicity ends. Any friction in the system will adversely affect the repeatability which needs to be avoided. Having said that, it pays to make sure the spring assembly is properly aligned and moves with no resistance, allowing the spring to do its work unhindered.

The other stumbling block with safety valves is the sealing surface for the actual valve, which is as good a place as any to start.



Steam dome showing safety valve.

The valve spindle is machined from solid stainless bar (**fig 29**). Starting with the thinner part of the spindle, this is machined in the three-jaw chuck the usual way. The taper or point is machined by flipping the part round and clamping it in the handy home-made collet described previously, cutting the angle using the taper slide. This operation needs to be done carefully so the TLC (take light cuts) principle applies. I generally machine tapers like this with the lathe spindle in reverse, cutting the back end. This way the taper slide handle is in the front so you don't need to lean over the lathe.

The safety valve body is, for the most part, a simple turning operation with the exception of the sealing surface. This needs to be machined using the same methodology as with all my clacks and valves (machining for a perfectly round hole). Just a reminder; when reaming the seating hole from the threaded side, make sure the full shank of the reamer is cleanly in the hole before the seating surface is reached. The outer periphery is simple machining and threading operations. Flip the safety valve body around and screw it into a tapped mandrel clamped in the three-jaw chuck. The valve spindle clearance can be bored out using a small boring bar. Remove the valve seat and clean up any burr with a little steel wool. Finally, the body is screwed back into the tapped mandrel and the valve spindle is held in a tailstock chuck with a little Brasso™ rubbed on the sealing surface. At a low speed, the valve seat is burnished using light pressure.

Hold the valve onto the seat and use the **tongue testing method** to check for a good seal. If you get a tongue leak check under a magnifying glass for the offending problem. Normally, it's a burr that needs to be removed; when the Brasso burnishing is redone you should get a good tongue seal.

The safety valve lever is a simple marking, drilling and filing exercise. Make sure to check the centre distances on the boiler to make sure everything aligns. In all likelihood the centre distances would have shifted a little. The cylinder at the end of the

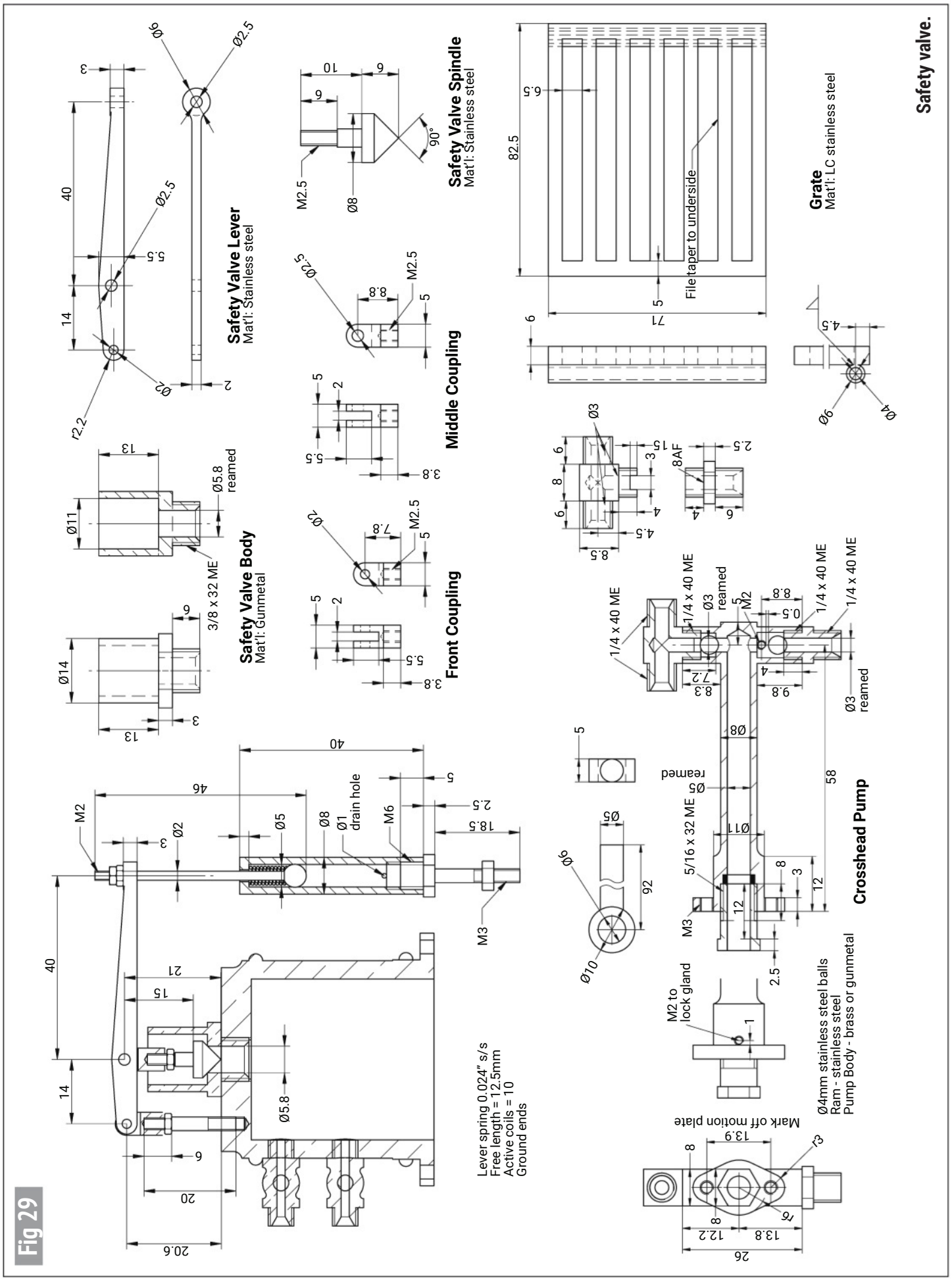
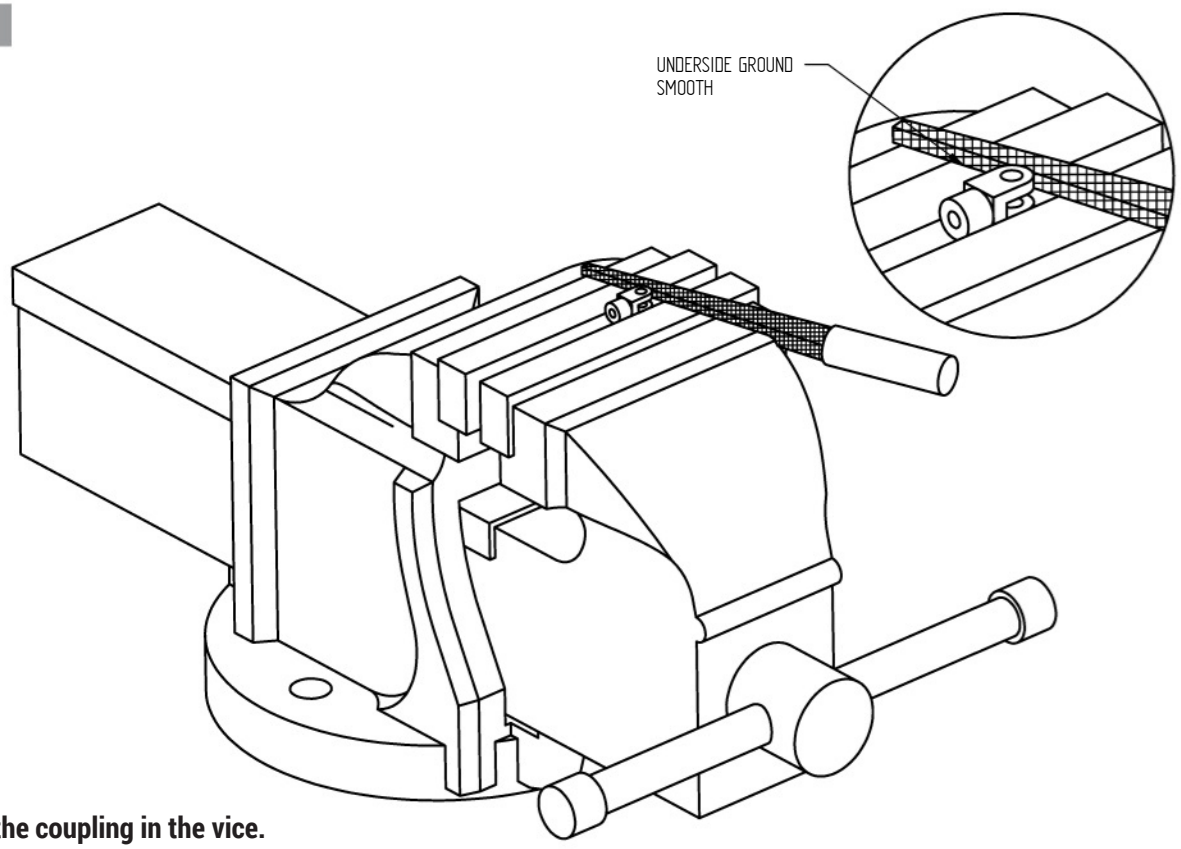

Safety valve.
Safety Valve Lever
Mat'l: Stainless steel
Safety Valve Spindle
Mat'l: Stainless steel
Middle Coupling
Front Coupling
Safety Valve Body
Mat'l: Gunmetal
Grate
Mat'l: LC stainless steel
File taper to underside
Crosshead Pump
reamed
5/16 x 32 ME
1/4 x 40 ME
3/8 x 32 ME
drain hole
M2 to lock gland
Mark off motion plate
Ø4mm stainless steel balls
Ram - stainless steel
Pump Body - brass or gunmetal
Lever spring 0.024" s/s
Free length = 12.5mm
Active coils = 10
Ground ends
Fig 29

Fig 30



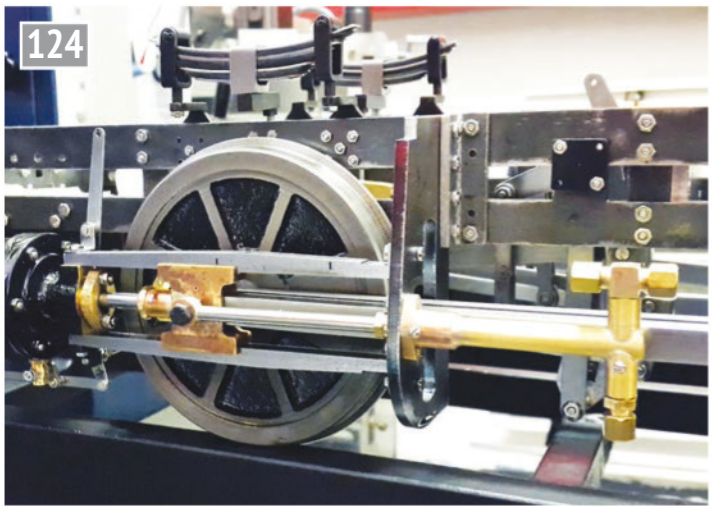
Shaping the coupling in the vice.

lever is machined with a slit filed into the side for location during brazing.

The spring, rod and ball at the end are all designed to allow for easy movement and low friction, allowing the spring to do its job unhindered. Any jamming due to misalignment of the sliding surface is bad, and will result in the safety valve blowing off at a higher boiler pressure.

The ball shaft is just a piece of TIG welding rod tapped on both ends. Drilling and tapping the ball bearing requires a little metallurgical gymnastics. The ball I used was a standard carbon steel ball from a discarded ball bearing. It's hard - a little tricky to drill and even more tricky to tap an M2 hole through. The hack is to soften the material by heating it red hot in a little dry sand, cover it in the sand and allow it to cool slowly. This process softens it enough for easy drilling and tapping in the lathe. I personally wouldn't dent the ball in a chuck, but rather clamp it in one of my trusty clamping collets that have made an appearance here and there through the series.

The manufacturing of the couplings requires some elaboration. There are a number of ways to tackle this job with the one described my humble method. I typically make a few of these components because they tend to be useful for all sorts of applications in model engineering. The square bar is held in a square bar collet described in Part 8 (M.E.4683, January 28). The end round and hole are machined and drilled in the lathe - I normally flip the bar around and do the same to the other end while I'm busy. The whole bar is moved to the drill where the shaft holes are drilled plumb centre. The couplings can then be parted off in the lathe or cut from the main stock using a hack saw. Generally, I make the slots with a slitting saw but it seems they are becoming more difficult to get hold of here in South Africa, especially the thinner sizes. If you have a small milling machine with a fast spindle, an end mill will do the job but very fast speeds with light cuts need to be taken to prevent breakage. Failing any of these tools the slot can be filed using a modified file with the coupling clamped length ways in a vice and the vice jaws used as a filing guide (**fig 30**). The modified file is any file really with the thickness ground to size and cleaned up with a flapper disk. I normally only thin the one side and leave two adjacent cutting edges, one for deepening the groove and the other for opening it up later. Make sure you use the clean side against the precious vice jaws!



Crosshead pump fitted.

Crosshead pump

The crosshead pump (**photo 124**) on the original prototype was removed at some point, from the pictures relatively early on in its working life. After completing the piping and running the locomotive I can understand why. For a locomotive that ran on a timber line with stumps lying around and a driver that's less than vigilant that pump

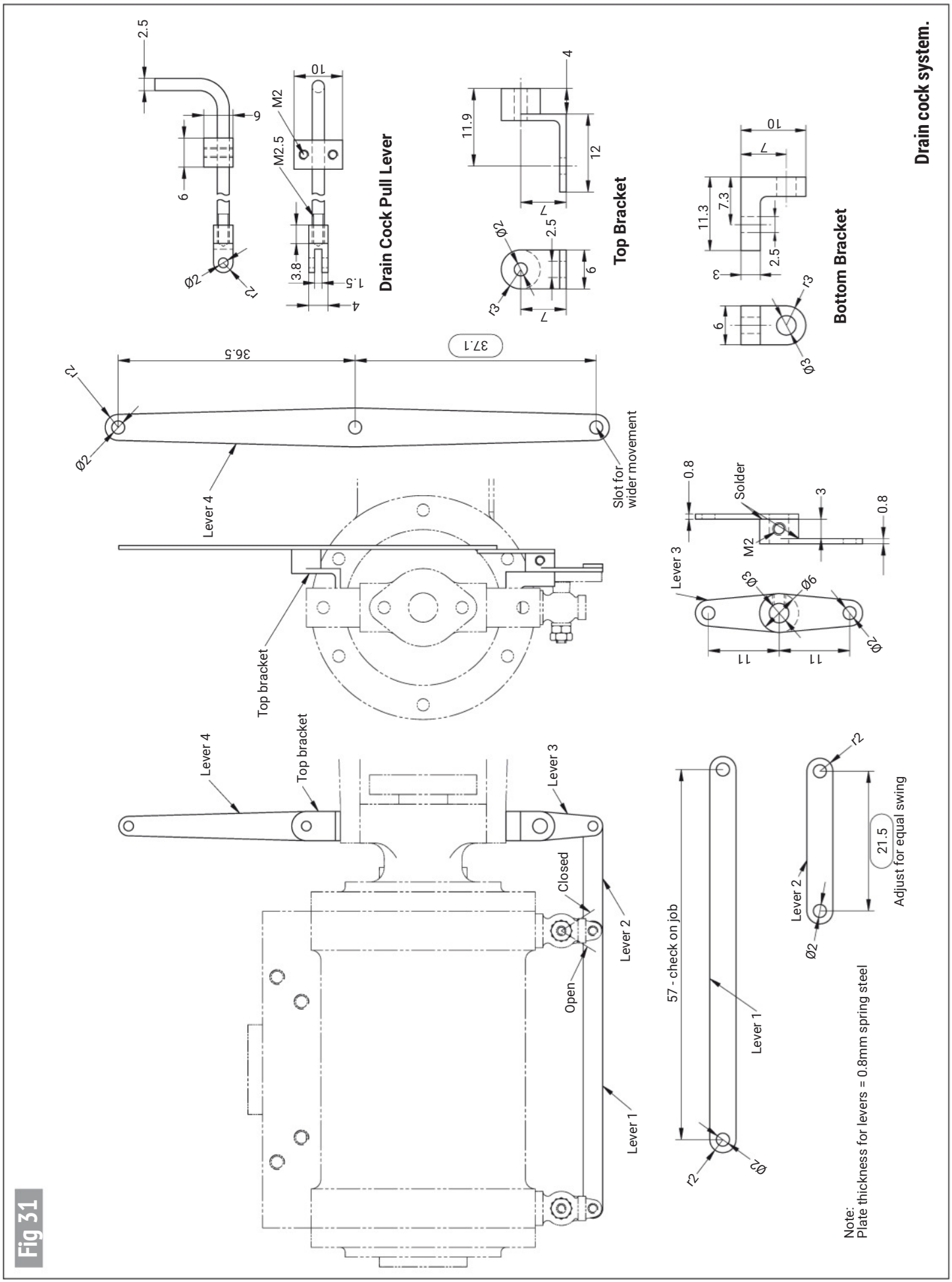

Drain cock system.
Drain Cock Pull Lever
Top Bracket
Bottom Bracket
Lever 4
Slot for wider movement
Top bracket
Lever 3
Solder
Lever 1
Lever 2
Closed
Open
57 - check on job
21.5
Adjust for equal swing
Note:
Plate thickness for levers = 0.8mm spring steel

Fig 31

would have been knocked very easily. For hobby steamers who generally have a clean track this is no problem; even a derailment on a ground track should leave the pump intact.

I machined the main body of the pump from a piece of brass riser which was big enough to make the flange profile (**fig 31**). The outside was machined to drawing and then parted off. The gland flange is machined in a similar fashion with all the holes marked out and drilled on the drill press. The flange and body are then bolted together with a neat profile filed using good old fashion radius guides. The assembly is marked and clamped in the three-jaw chuck to drill the ram hole which, of course, should be drilled undersize and finally reamed.

The remaining bits for the body are simple machined components soldered to the main body with Tipp-ex'd screws holding the lot in place. Machining a convex on the fittings will give a neat joint that is easy to solder. When soldering the lot together keep a steel rod down the reamed bore to manage any heat distortion and oxidation.

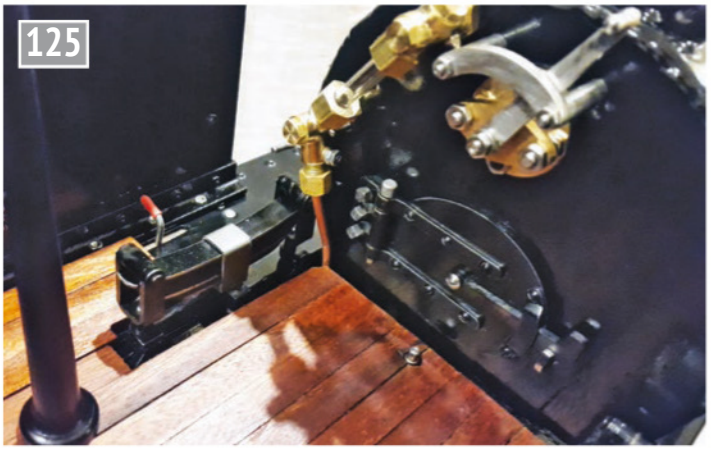
The end of pump ram was drilled and tapped with the crosshead bearing given the same treatment; the two components were screwed together and brazed. One of the advantages of joining using silver solder is that dissimilar materials can be joined. In this case, the pump ram is made from free machining stainless and the bearing from phosphor bronze. Liberal clearance can be machined to the crosshead spindle to take up any tolerance issues when fitting the pump.

All the ball seats should be tapped with a brass rod and hammer for a decent seal but this is a water pump and doesn't require a steam seal so I wouldn't be too pedantic if you don't get it perfect. The efficiency of the pump will be compromised but it's not the end of the world for our little models.

The small screw by the flange is to lock the gland nut when set. These tend to work themselves loose on the track and I have seen many efforts to stop it from coming undone but the locking screw seems to be the most reliable and unobtrusive solution.

Fire grate

The fire grate is a laser cut component, which requires little description. On my model I didn't even bother filing a taper to the underside of the grate (with no ill effect) but to be thorough I decided to put it into the drawings. My personal feeling is the grate isn't thick enough for the anthracite to clog up the works. The bottom of the boiler was designed to have the grate rest on two 4mm rods that can be pulled out to drop the fire. A simple ash pan can also be fitted if so desired. On my locomotive I welded a piece of stainless pipe to the underside making the grate fixed on the one side. The pin on the other end is pulled out to drop the fire and the grate is kept on the locomotive - so no chance of getting left at the club.



Drain cock push rod as viewed on footplate.

Drain cock levers

A drain cock lever with a push-pull system was used for the model (fig 31). The push rod runs under the running boards to the footplate where the rod is simply bent over to make a simple neat handle (**photo 125**).

All the levers were made using the high tensile strapping which the leaf springs were made from. The holes are centre punched and drilled on a piece of plastic or hard wood, properly clamped to the table to prevent the drill from biting into the job and taking a finger off! All edges are rounded using a file and radius guides. Lever 3 has a centre cylinder soldered to the plate to lock to the lever shaft that runs under the locomotive. The same lever is used on the right-hand side of the locomotive, but the top part is left off.

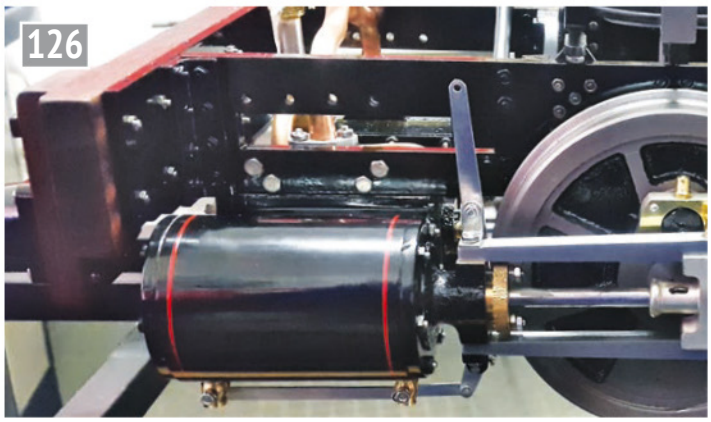
Two brackets at the top and bottom of the crosshead slide bar make the pivot points for the lever mechanism. The bottom bracket can be made from some angle iron with the top bracket a soldered assembly using the same strapping as the links.

The push pull rod and lever fit nicely under the running boards (**photo 126**) with a notch filed at the top of the motion plate when the final position of the footplate handle has been fixed. The rod needs to be kept straight; if it's bent at any point the movement of the lever will be adversely affected.

The coupling at the end of the rod was made in a similar fashion as the safety valve couplings but, again, I used a slitting saw where builders with limited tooling can use a hacksaw with two blades fitted to get the correct gap. Modifying a file to this size as with the safety valve couplings might be a bit of a stretch. Brass as a material for this coupling will be more than adequate and is easier to work with.

The pull rod bearing block is a simple square piece from the leftovers of the running board square edging and shouldn't give any issues. The block is fitted as close as possible to the slot in the running board with two countersunk screws holding it in place. The rod itself was just a piece of TIG welding filler wire, actually measuring 2.4mm but close enough and works just fine. With the whole assembly fitted check the travel of the drain cocks and make sure the drain cock taper swings to both sides of the drain cock body. If it doesn't, you'll need to slot the bottom hole of lever 4 to increase the travel. Don't slot the link too much or the drain cock levers will go past the centre line and lock up.

To finish off the handle neatly above the footplate a little shrink wrap will give it a softer look. The lever should be bent towards the side panels to avoid any tripping hazards!



Drain cock levers behind cylinder end cap.

●To be continued.

Club Diary 13 August - 25 September 2022

August

13/14 West Riding Small Locomotive Society
Rally/Open Weekend. Contact: Stuart Merton on 01132 523258 or wrslsec@gmail.com

14 Guildford MES
Open Day, Stoke Park, Guildford 14:00 – 17:00. See www.gmes.org.uk

14 North Wilts MES
Public Running, Coate Water Country Park, Swindon 11:00 – 17:00. Contact: Ken Parker, 07710 515507

17 Bristol SMEE
ZOOM Meeting – BRIMLEC/IMLEC Review. Contact : secretary@bristolmodelengineers.co.uk

20 Cardiff Model Engineering Society
Steam-up and Family Day, Heath Park, Cardiff. See www.cardiffmes.co.uk

20/21 Model Tram and Railway Exhibition
National Tramway Museum, Crich Tramway Village. See www.tramway.co.uk

21 Bradford MES
Running Day, Northcliff R ailway 13:30 – 16:00. Contact: Russ Coppin, 07815 048999

21 Bristol SMEE
Public Running, Ashton Court Railway, BS8 3PX, noon – 17:00. Contact : secretary@bristolmodelengineers.co.uk

21 North Wilts MES
Public Running, Coate Water Country Park, Swindon 11:00 – 17:00. Contact: Ken Parker, 07710 515507

25 Guildford MES
Open Day, Stoke Park, Guildford 10:00 – 13:00. See www.gmes.org.uk

25-29 Great Dorset Steam Fair
Tarrant Hinton, Blandford Forum. See www.gdsf.co.uk

28/29 Bristol SMEE
Public Running, Ashton Court Railway, BS8 3PX, noon – 17:00. Contact : secretary@bristolmodelengineers.co.uk

28/29 Cardiff Model Engineering Society
Public running, Heath Park, Cardiff 13:00 - 17:00. See www.cardiffmes.co.uk

28/29 North Wilts MES
Public Running, Coate Water Country Park, Swindon 11:00 – 17:00. Contact: Ken Parker, 07710 515507

28 York Model Engineers
Open Day. Contact: Bob Polley, 01653 618324

September

3 Southport MEC
Small Gauges Day, Victoria Park 10:00 – 16:00. Contact: Gwen Baguley, gwenandderrick@yahoo.co.uk

3/4 Sutton Coldfield MES
Federation of Model Engineering Societies Rally, Little Hay, Lichfield. See www.scmes.co.uk/rally or contact: Martyn Cozens, scmessec@gmail.com

4 North Wilts MES
Public Running, Coate Water Country Park, Swindon 11:00 – 17:00. Contact: Ken Parker, 07710 515507

7 Bradford MES
September Meeting, Saltaire Methodist Church 19:30. Contact: Russ Coppin, 07815 048999

7 Bristol SMEE
Wilton windmill restoration, Begbrook Social Club BS16 1HY. Contact : secretary@bristolmodelengineers.co.uk

8 Cardiff Model Engineering Society
Talk: Medieval Cardiff, Heath Park, Cardiff. See www.cardiffmes.co.uk

10 Cardiff Model Engineering Society
Steam-up and Family Day, Heath Park, Cardiff. See www.cardiffmes.co.uk

10 York Model Engineers
Evening Talk – 19:00. Contact: Bob Polley, 01653 618324

11 Ayesha Centenary Rally
Rugby MES 10:00 – 17:00. See www.n25ga.org

11 Bristol SMEE
Public Running, Ashton Court Railway, BS8 3PX, noon – 17:00. Contact : secretary@bristolmodelengineers.co.uk

11 North Wilts MES
Public Running,cCoate Water Country Park, Swindon 11:00 – 17:00. Contact: Ken Parker, 07710 515507

17 Bromsgrove SME
Rob Roy Rally, Avoncroft Museum. Contact: Rex Hanman, 01980 846815

18 Bradford MES
Running Day, Northcliff Railway 13:30 – 16:00. Contact: Russ Coppin, 07815 048999

18 Bristol SMEE
Public Running, Ashton Court Railway, BS8 3PX, noon – 17:00. Contact : secretary@bristolmodelengineers.co.uk

18 Cardiff Model Engineering Society
Public running, Heath Park, Cardiff 13:00 - 17:00. See www.cardiffmes.co.uk

18 Guildford MES
Open Day, Stoke Park, Guildford 14:00 – 17:00. See www.gmes.org.uk

18 North Wilts MES
Public Running, Coate Water Country Park, Swindon 11:00 – 17:00. Contact: Ken Parker, 07710 515507

21 Bristol SMEE
ZOOM Meeting – 'World's Crane Makers'. Contact : secretary@bristolmodelengineers.co.uk

23-25 East Somerset SMEE
Open Weekend at the Bath and West Railway near Shepton Mallett. See openweekend@essmee.org.uk or contact: Michael Malleson, 01747 860719

23-25 Llanelli and District Rally
Pembrey Country Park, Llanelli. See llanellianddistrictmodelengineers.wordpress.com

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www.classicmagazines.co.uk/renew/me1

Engineering's Local Heroes

Dorothée Pullinger of Scotland and Guernsey

Roger Backhouse tells the story of Dorothée Aurélia Marianne Pullinger, creator of the Galloway car.

For whatever reason, engineering remains a largely masculine occupation but go back a hundred years and it was even more male dominated. Women engineers of the 1920s and later had to fight against real discrimination in order to make their way in their chosen profession. Those that succeeded were often brilliant at their work – they simply had to be exceptionally good to survive.

One such success story is that of the remarkable Dorothée Aurélia Marianne Pullinger (**photo 1**), creator of the Galloway car. Dorothée was born in France in 1894, the oldest of twelve children. Her father was Thomas Pullinger, a car designer who had worked for Darracq. He brought his family to Britain in 1902 and Dorothée attended Loughborough Girls Grammar School.

Dorothée Pullinger with her creation, a Galloway car. (Image courtesy of the family of Yvette Le Couvey.)

An Arrol-Johnston 15.9hp car built at Paisley in 1912. (Roger Backhouse 2021. Courtesy of Glasgow Museums.)

Her father worked for various car companies before becoming managing director of the Paisley works of the Arrol-Johnston Company, a pioneering Scottish car maker. The firm had a modern and largely integrated factory where most components were made on site. As Managing Director he introduced a new range of cars in 1909 (**photo 2**).

Dorothée started working there as her father's apprentice in the drawing office. As a girl she was an accomplished watercolour painter and her sketchbook from 1908 survives. Perhaps those artistic skills helped her in the drawing office. In 1914 she applied to join the Institution of Automotive Engineers but her application was rejected on the incredible grounds that 'the word *person* means a man and not a woman.' Although she had been offered Associate Membership - which she refused - Dorothée was eventually admitted to full membership in 1921, the first female member of the Institution.

At just twenty years old, Dorothée was put in charge of women munitions workers at Vickers, Barrow in Furness. She spoke French well and this could well have been a reason for her appointment as, apparently, a significant number of Belgian and French refugees worked there. (My grandmother was a munitions worker in Barrow and may have been one of her charges.) As a manager, Dorothée introduced a canteen for the workforce which eventually supplied 7000 meals a day; no mean feat in itself, but Dorothée always had remarkable energy and was, in 1920, awarded the MBE for her wartime efforts.

Post war, Dorothée returned to Scotland and to automotive engineering, restarting her engineering training. Arrol-Johnston had a subsidiary,

the Galloway Engineering Company, with a factory at Tongland near Kirkcudbright. Here Dorothée helped the early design, development and production of the Galloway car playing a leading part in making it a success.

The factory was, to a great extent, staffed by women and offered them a three year apprenticeship - rather than the five year apprenticeships normally given to men as, of course, women were expected to be quicker learners. The women typically lived at a hostel on site.

Described by *Light Car and Cycle* magazine as a car 'made by ladies for others of their sex', the Galloway was smaller, lighter and cheaper than Arrol-Johnston's 15.9hp model and most others of the period. It had innovations like a rear view mirror and a hand brake more conveniently located near the driver's seat (a change to the previous practice of placing it beneath the dashboard). The gear change was placed in the middle of the car rather than outside the body. The steering wheel was smaller, the seat higher and the dashboard was lowered. These were all welcome innovations for all drivers, not only the women they were intended for.

Unfortunately, the Tongland factory lasted only three years before production was moved to the Arrol-Johnston factory at Heathhall outside Dumfries.

The first model, the 10/20, was based on a Fiat 501 design and had a 1460cc side valve engine. In 1925 it was replaced by the 1669cc 12/20 and 12/30 models. Early cars had rear wheel brakes only but by 1925 all wheel braking had become normal practice.

Many independent car makers faced difficulties in the 1920s. Even though four thousand Galloway cars had been made, production ended by 1928 when Arrol-Johnston closed. With Galloway cars priced at £325 to £360 depending on chosen body style, it was hard to compete with mass market manufacturers like Morris and Austin.

The 1924 10.9hp Galloway coupé in Glasgow's Riverside Museum. It has a much lighter style than the Arrol-Johnston built just 12 years before. (Roger Backhouse 2021. Courtesy of Glasgow Museums.)

Beside engineering, Dorothée had other distinctions. She was an early member – indeed, some sources say a founder - of the Women's Engineering Society set up by Katherine and Rachel Parsons in 1920. A keen driver as well as an engineer she was awarded a silver medal for racing in 1922 and in 1924 became the first woman competitor in the annual Scottish Six Days Trials, winning a silver cup.

Dorothée married ship's purser, Edward Marshall in 1924 and they had two children. A staunch Conservative, she served as the only woman on the Industrial Panel of the Ministry of Production during the Second World War, also contributing to a 1944 report on the future of British industry. Some sources say she was also employed to recruit women for munitions factory work.

After Arrol-Johnston's closure Dorothée and her husband established White Service Laundries in Croydon. They used modern American machinery and the business was a success, eventually running seventeen shops. When they sold the laundry firm in 1946 they then moved to Guernsey, this time setting up Normandy Laundries which operated successfully for many years.

Dorothée died in 1986 aged 92. Fittingly, she was inducted into the Scottish Engineering Hall of Fame in 2012. A Galloway car is displayed in Glasgow's Riverside Museum, believed to be one of just fifteen surviving. Another is in the Myreton Motor Museum, Aberlady, East Lothian. Only four examples remain in Scotland of a car that once promised so much, but Dorothée Pullinger's inspirational legacy lives on.

Thanks to Suzanne Rough, Glasgow Museums, for considerable help with this article and to the family of Yvette Le Couvey for images. Thanks also to Wikipedia and Herstoria websites.

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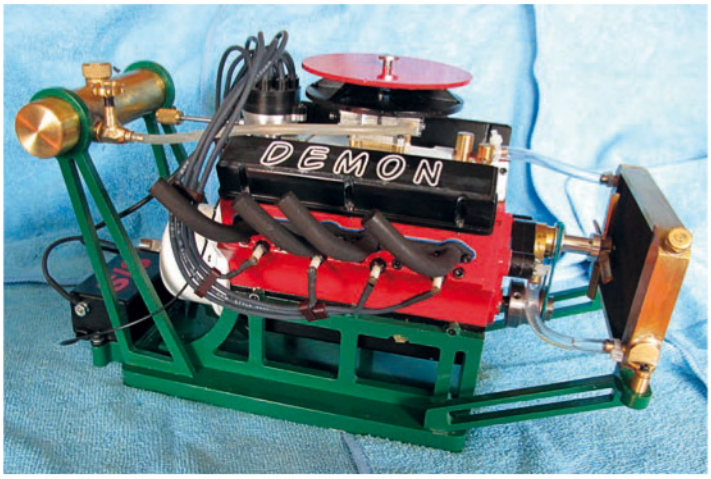
Dorothée's daughter, Yvette Le Couvey at the wheel of the car her mother helped design and engineer. (Image courtesy of the family of Yvette Le Couvey.)

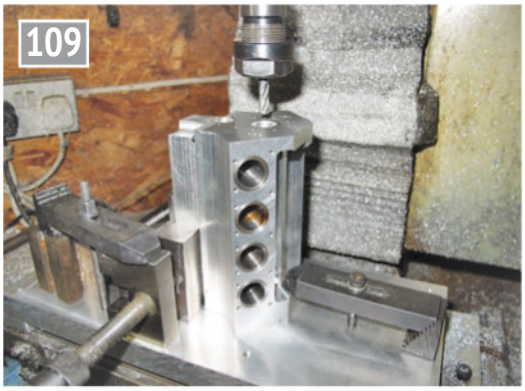
The *Little Demon* Supercharged V8 PART 11

Mick Knights describes the construction of a supercharged V8 internal combustion engine.

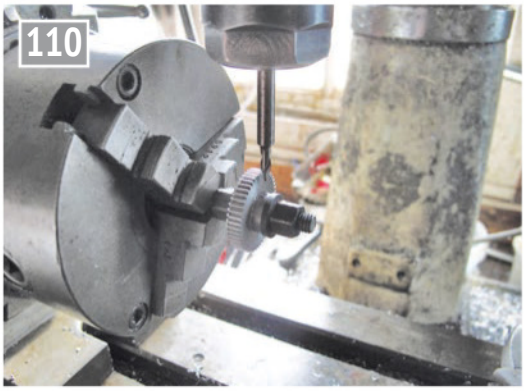
Continued from p.215
M.E. 4696, 29 July 2022

Back now to the cylinder block. The timing gear pockets need to be produced in the front face and the CNC is the obvious choice (**photo 109**). A modification is required to the camshaft timing gear; two M3 holes are produced at right angles to accept grub screws (**photo 110**) and two corresponding flats are produced on the end of the camshaft to locate and secure the gear (**photo 111**). To ensure the second flat is at 90 degrees to the first it is located squarely against the vice jaw using feeler gauges. It's a good idea to align one of the flats with the centre line of No. 1 exhaust cam; this can then be used as a visual indicator for the position of this cam when setting the valve timing on final assembly.



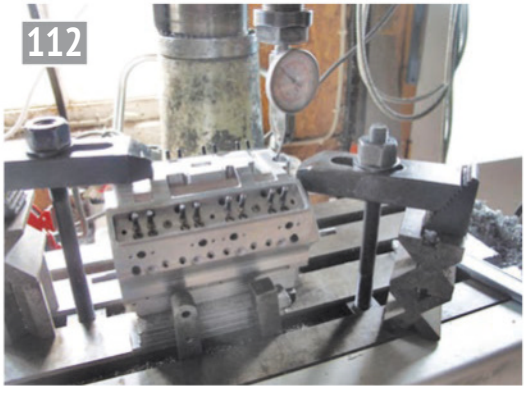


Crankcase assembly set to machine timing gear pockets.



Centring the two M3 holes in the timing gear.

Machining the first grub screw locating flat.

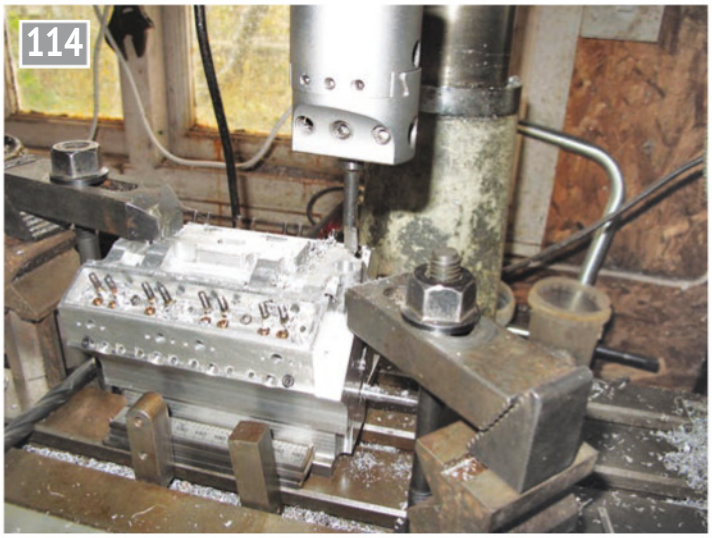


Setting the manifold bore true to the machine spindle.

The hub on the crankshaft timing gear needs to be shortened to 0.062 inch before bonding to the crankshaft. To ensure no bonding fluid came into contact with the front bearing, a paper gasket to sit between the two was produced using ½ inch and ¼ inch diameter gasket punches.

Now would be a good time for a quick word about the choice of gear supplier. I asked for a quote for all the gears required from the recommended supplier in the USA, but when I received it I was a bit surprised as I hadn't expected them to be produced from precious metal - well judging from the prices they must have been! - and that was before carriage and import charges. After several quotes from suppliers both in the UK and the USA the cheapest by a long way (for all the spur gears) was HPC Gears. I've sourced the water pump gears and the distributor drive gears from different suppliers which I'll cover when we reach the appropriate stage of the build.

Drilling.



Final boring to size.

Now that the cylinder heads and manifolds have been successfully bolted into their final positions on the engine block it's time to transfer the position of the distributor bore in the manifold to the block. As this needs to be a close working fit in the engine block I prefer to line bore both components rather than just drilling the cylinder block. It is envisaged that the single carb manifold will be used for running the engine so it is used as the reference for the bore transfer. With the head and manifold assembly secured to the block the bore is clocked true beneath the machine spindle (**photo 112**). The bulk of the material is removed using a suitable stub drill (**photo 113**). Final size is achieved by boring. The bore in the cylinder block needs to be a good sliding fit to the distributor, while the bore through the manifold needs to be enlarged by about 0.020 inch to allow for movement on assembly (**photo 114**). The distributor bore in the blower manifold was generated at the same time as the single carb version and so should be a pretty close fit to the bore in the engine block when assembled - but may need a revisit in order to allow the distributor shank to pass into the engine block.

The distributor body was machined from a suitable piece of aluminium FC1 (**photo 115**). A mounting flange that will mate against both manifold blocks, along with a radial slot that will allow rotation when timing the engine were generated on the CNC (**photo 116**) and the internal detail was produced in the same way (**photo 117**). A mating distributor cap was also generated on the CNC from a convenient piece of black nylon (**photo 118**). A programming hint for any CNC-ers: if the diameter of the upstanding terminal bosses is programmed at 6mm, then by using a 2mm diameter cutter it should produce the result shown in **photo 119**.

Turning the distributor body.

Generating the mounting flange.

The internal detail.

Mating diameter in the distributor cap.

Two of the internal components were produced at the same time. The rotating disc that houses the eight magnets that operate the Hall sensor was generated complete on the mill, then set in the lathe and parted off to finished length. The bores were made 0.124 inch diameter to accept the 0.125 inch body of the magnet (**photo 120**). The distributor rotor was produced from a piece of Tufnol sheet. The brass contactor strip was produced from sheet brass 2mm wide and 2mm deep. The slot in the rotor was produced using a 1.5mm diameter carbide cutter on a keyway cutting cycle in order to leave a 0.002 inch clearance for the bonding. Once bonded in position the initial face clear cycle was 0.2mm deep on a round pocket cutting cycle (**photo 121**). A circle cutting cycle produced the round blank, which was set in the

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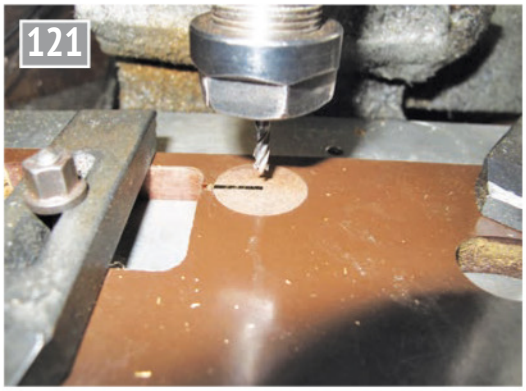
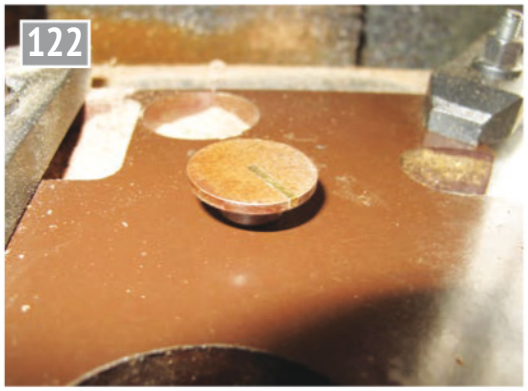
Finished distributor body.

The magnet mounting rotor.



Facing the rotor face and brass electrode.



The finished rotor.

lathe to produce the 0.250 inch diameter hub and a 0.125 inch diameter hole for mounting on the drive spindle (**photo 122**). The drawing and instructions for setting the timing do say that the brass contactor strip should be glued to the top face of the rotor once the engine timing has been established, but I left the rotor end of the drive spindle plain, without the drawn flat shown on the drawing, so without the rotor's securing grub screw locking and locating against a flat on the drive shaft, the rotor can be correctly positioned and locked during the timing. That's my choice; I'm not saying that one method is any better than the other.

We'll return to the distributor on final assembly, but now to finish off the single carburettor manifold by producing the air filter - or as our transatlantic cousins like to call it, the air scrubber.

This may be a bit boring for conventional machinists as, again, I took the CNC route to produce the six wedge shaped pockets around the body which will channel the air to the carburettor.

I have mentioned in previous builds that I don't have a CAD capability but this is no longer strictly true as I signed up to the recent series of tutorials for the Albrie CAD package in *MEW* and had a lot of fun following the step by step instructions to produce a 3D scribing block. I did have several attempts at designing a few fantasy components but, in the end, when it comes to writing a program for the mill I'm still very much old school and I find it far quicker to use a mixture of G-code and conversational wizards, rather than draw out the CAD component and put it through a CAM post processor.

I programmed the clearance cutter path for the wedge shape pockets then called up G68 co-ordinate rotation to repeat it at six sixty degree positions to create all the pockets in one cycle.

Incorporating G68 is so easy. There's only one simple rule to remember: all rapid and feed moves must be within a sub routine. After the program header the next two lines are:

G68 A0B0R-60 (Using a Mach3 control A = the X centre position, B = the Y position and R = the angular rotation).
M98P1001 (Call the subroutine at the above position.)

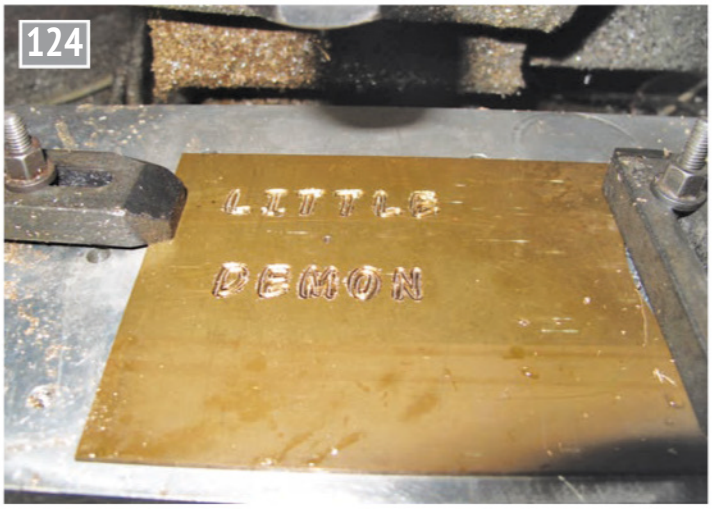
All subsequent R values will be the last value plus 60 degrees, so the next R value would be R-120.

G68 is not only useful for machining features at regular intervals but also for plotting holes at different angular positions on a fixed PCD.

Rather than incorporate the Z minus feed moves in the sub routine I find it easier to run the program to cut at all six positions at one depth then add the next Z minus move via the edit as sometimes - but by no means always - my Mach3 control bombs when running G68 and by not having the Z moves in a sub routine it makes it a whole lot easier to reset. As I say, G68 does strange things to my control, especially when using the conversational wizards to create arcs, as the graphics in the wizard display window aren't always the same as those that appear in the program run window and although the accompanying G-code is correct the control doesn't appear to have a home reference and sends the cutter off on a walkabout. I find I can cure this by simply rebooting the computer, but with this in mind I always prove a G68 program by running the first couple of angular moves on a piece of scrap material before running the whole program on the actual work piece.
On this occasion, due to a combination of cutter diameter and the angular start and finish positions, the web between the pockets turned out to be slightly tapered rather than parallel as drawn. I could have gone back and reprogrammed the pocket, using a smaller diameter cutter to generate a smaller corner radius rather than forming it with the cutter itself, which would probably have had the desired effect on the web … but …

Back in the early 1970s I spent several happy years working for a one man

The air scrubber pockets.



Engraving air scrubber cover plate.

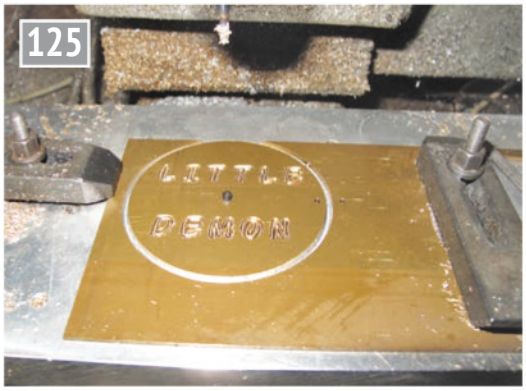
band construction business building swimming pools and surrounding hard landscaping. On one job we had to build a large retaining wall against an excavated bank using reclaimed sandstone blocks salvaged from a church demolition. These were, as you can imagine a bit on the big side, but as we were on a price for the whole job, we motored into it laying several more courses that the usual three a day. The next morning when we arrived back on site the customer was waiting for us and demanding an explanation as to why all the blocks were leaning inward at an angle rather than sitting vertically as he was expecting. Ted, the chap I was working for, quick as a flash said that in order to properly retain the bank the blocks had been deliberately laid on the incline. The customer seemed to accept this, but my first job of the day was to make a large wooden angled square to match the profile of the subsided blocks in order to carry the same angle to the top of the wall. The moral of the story is: sometimes the best way to overcome a mistake is to emphasise it and make a it feature!

Photograph 123 shows the air scrubber with tapered webs between the pockets.

For a bit of contrast, I made the scrubber cover plate from 1/16 inch thick brass. As this was to be completely generated on the CNC, a M2 hole was drilled and tapped in the aluminium sub table and the position taken as absolute zero. This would be used to captivate the finished plate at the end of the cut circle cycle. The first operation was to drill a 2mm hole in the plate at X0Y0. Only because I can, I engraved 'Little Demon' around the centre of the plate using a font named 'Action Man' (**photo 124**). If this doesn't look attractive on final assembly, the cover can be reversed to show the plain face.

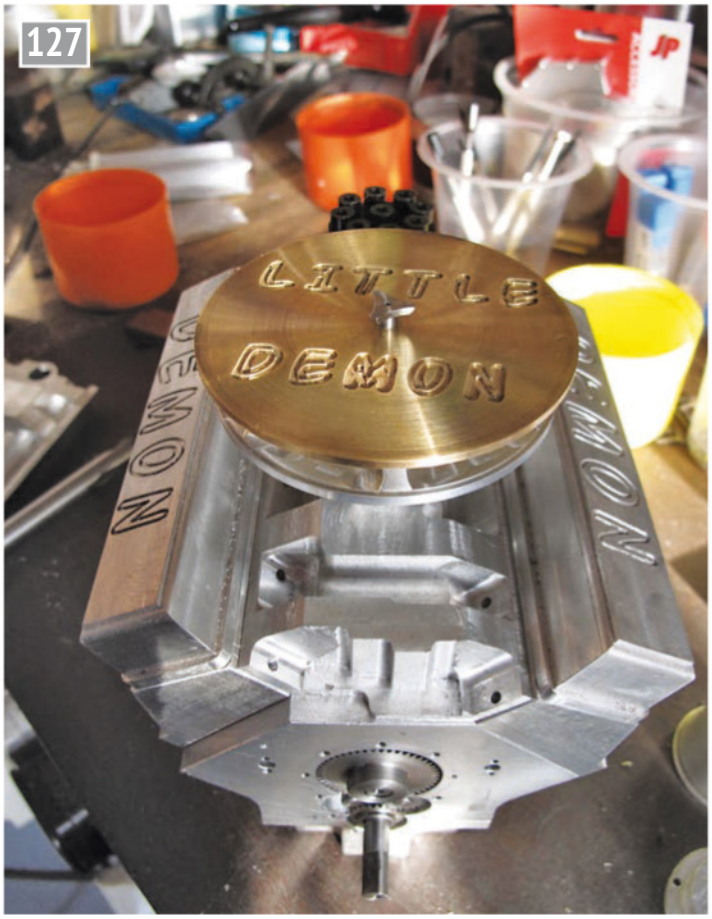
A cut circle cycle completed the manufacture of the cover plate (**photo 125**). The M2 thumb nut for securing the cover plate to the scrubber body was produced in stainless steel 303. First the body was turned on the lathe and the chuck transferred to the mill where the three scallops were generated. Finally, back to the lathe to be parted to length (**photo 126**). The completed single carburettor manifold is shown in **photo 127**.

●To be continued.



Generating cover plate diameter.

M2 thumb screw.



Air scrubber in position.

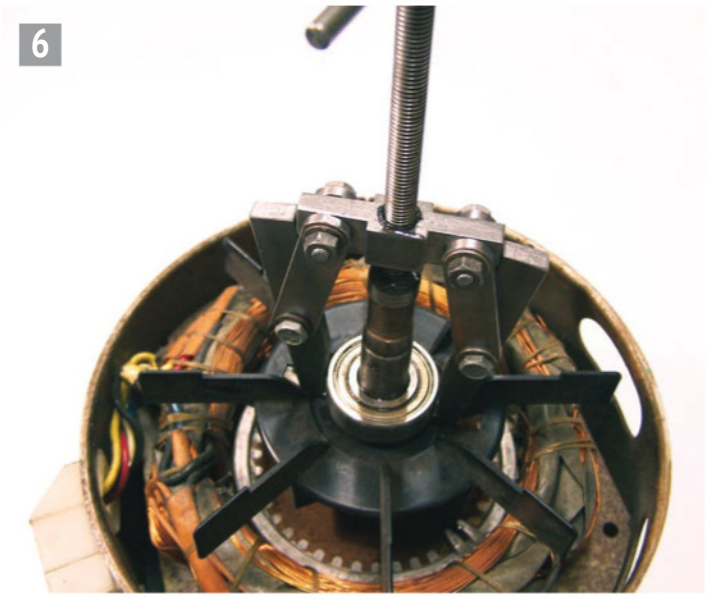
Rewinding a Two Speed Motor PART 3

Graham Astbury learns a lot about single-phase induction motors and describes 'The long and winding road that leads to a 2-speed single-phase motor'.

Continued from p.226
M.E. 4696, 29 July 2022

Reverse engineering

At this point, I had a perfectly good motor which worked yet I had no use for it in its original form. It seemed an act of unspeakable vandalism to attack the windings and destroy a perfectly good working motor but I needed to determine the turns for each winding. I dismantled the motor and after removing the end bells, I was left with the rotor still inside the stator, as the motor had *two* large fans – most unusual – and hence I had to remove at least one fan to be able to extract the rotor. The fan at the non-drive end seemed to be moulded onto the shaft and, since it did not have any easy way of fitting a bearing puller, I decided that I should leave that fan alone and investigated the other fan. This was mounted between the rotor and the drive-end bearing with very little clearance at all. Fortunately, there were two small cut-outs moulded into the fan, presumably to fit a small bearing puller to allow the bearing to be pulled off the shaft (**photo 6**). Unfortunately, my bearing pullers were all three-legged and too large to fit the slot, so I had to make a small puller. This was described previously (**ref 11**).



The purpose-made bearing puller to fit the fan openings.

Having dismantled the motor, I counted the rotor bars, as the ratio of rotor bars to stator slots can create a problem with noise caused by harmonics. It can be imagined that if the rotor has 32 slots and hence teeth and the stator also has 32 teeth and slots, when the rotor goes round, the magnetic flux from the stator teeth passing into the rotor teeth will tend to hold the teeth in alignment and as the teeth move, the flux will jump to the next tooth, resulting in uneven rotation of the rotor. This is known as cogging and is a function of the number of poles, the number of stator slots and the number of rotor slots. As I was proposing to alter the number of poles, by altering the speeds from 2-pole and 16-pole speeds to 4-pole and 8-pole speeds, I thought it prudent to check that this would not produce problems with noise. I decided to have a further literature search on noise in induction motors to make sure of that. Apart from Appleman (ref 3 – M.E.4695, July 15), which was predominantly concerning single phase motors with one main winding and a starting winding, I found that Hildebrand (**ref 12**) gave a simple rule for minimising noise in any induction motor which was that '*...a motor will be quieter if the numbers of poles, stator slots, rotor slots, difference of stator and rotor slots bear a simple multiple relationship and the motor is quieter the larger the greatest common divisor of these factors...*'. Taking the stator, rotor and proposed changes to the number of poles into account, at the two different speeds the salient numbers are laid out in **Table 1**.

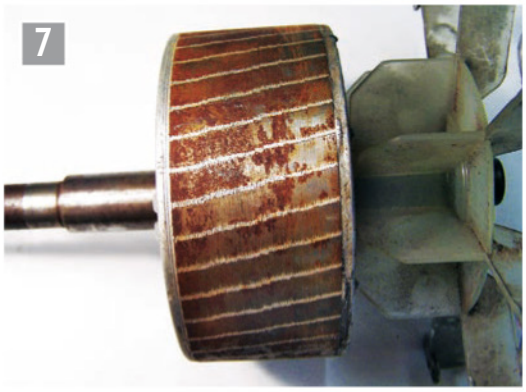
This should give a relatively quiet motor. This also agrees partly with Appleman (ref 3), who states that conditions to be avoided are:

Table 1. Factors for predicting motor noise (after Hildebrand)

Number	Four pole speed	Eight pole speed
Poles	4	8
Stator slots	32	32
Rotor slots	40	40
Difference between stator and rotor	8	8
Greatest common divisor	4	8

1. an odd number of slots in the rotor,
2. a difference in the number of rotor and stator slots being half the number of poles,
3. the number of slots on the rotor and stator differing by the number of poles.

In the case of the washing machine motor, *in its original form of 2 and 16 poles,* it avoided all three of Appleman's conditions in the 2-pole mode but condition 2 was present in the 16 pole mode, as the difference between the stator and rotor slots was 8 which is half of the number of poles. In the rewound form of 4 and 8 poles, all conditions would be avoided in the 4-pole mode, but condition 3 would be present in the 8-pole mode. Consequently, I would have to hope that whilst two conditions were avoided as in the original windings, the different condition that would be present did not give rise to unacceptable noise.



The rotor showing the skewed slots.

The windings from one slot separated from the rest.

However, Appleman also states a 'general condition' of '*...any rotor with a number of rotor slots divisible by the number of pairs of poles of the fundamental and which differs from the number of stator slots by more than the number of poles will probably be a quiet rotor'.* Again, in the original motor, this was not satisfied when running in 16-pole mode, as the difference between the rotor and stator slots was less than the number of poles, but was satisfied in 2-pole mode. In my case, this would be satisfied on the 4-pole high speed, but not necessarily on the 8-pole low speed as the difference between the stator and rotor slots is equal to, rather than more than, the number of poles. As the original motor was actually quiet on both speeds, I was reasonably satisfied that the motor would not be noisy. Also, Appleman states that skewing the rotor slots would reduce the effect of noise, with the most effective skewing being one complete stator slot. As can be seen in **photo 7**, the rotor is indeed skewed by one slot. Whilst the above did suggest that there *might* be a problem with noise for the 8-pole speed, I decided to go ahead anyway and hope that I would be successful with this rewind as a 4-pole/8-pole motor.

Wiring of the motor washing machine motor coils and the speed changing switch.

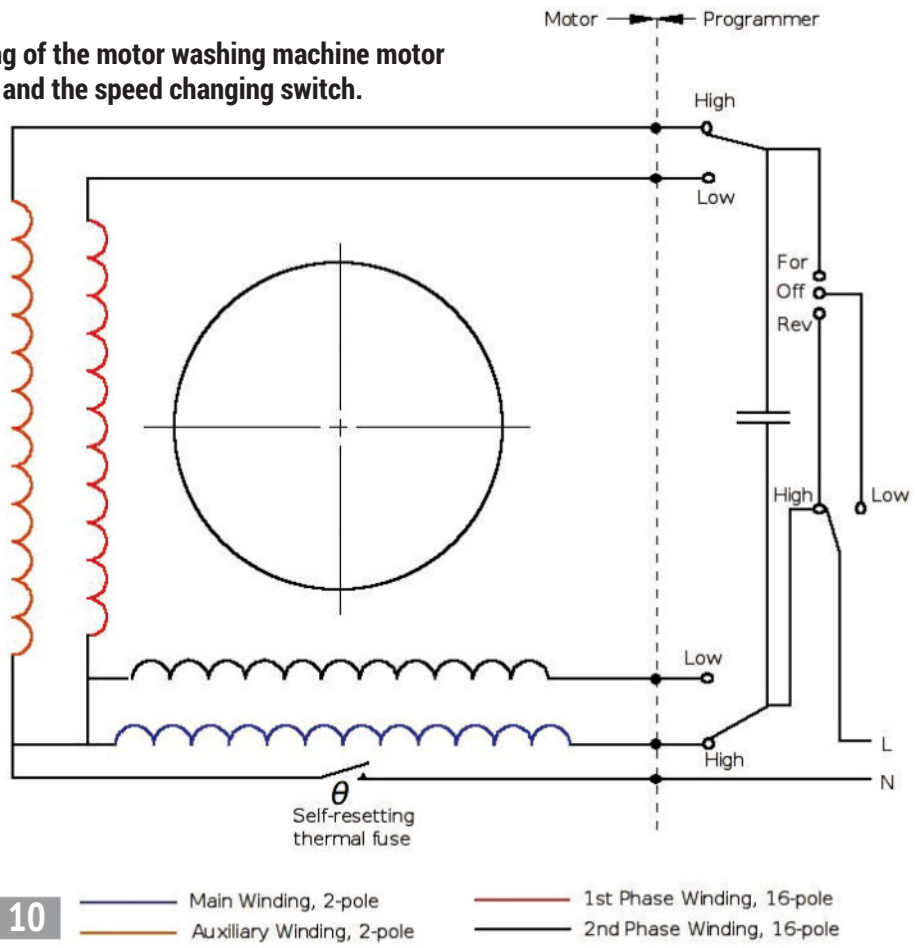


Fig 10

Counting the turns

Before I started anything too drastic, I measured the resistance of the windings so that I could be sure of which winding I was about to count. There were four windings – one main and one auxiliary for each speed, arranged with one common point wired up as in **fig 10**. The resistance of the windings was as in **Table 2**.

From these values, it is apparent that the two 16-pole windings are the same and the motor is easily reversible with a single-pole changeover switch. Since the main and auxiliary windings are identical on the 16-pole speed, the supply can be fed to either winding and the capacitor could also feed either winding, so the motor can be reversed easily by simply changing the connection to the opposite side of the capacitor, as in fig 10. For a washing machine, this is the typical *modus operandi* of the drum when washing - rotating one way and then reversing.

Table 2. Original winding resistances

Winding	Resistance
2-pole main	15 Ω
2-pole auxiliary	39 Ω
16 pole main	54 Ω
16 pole auxiliary	54 Ω

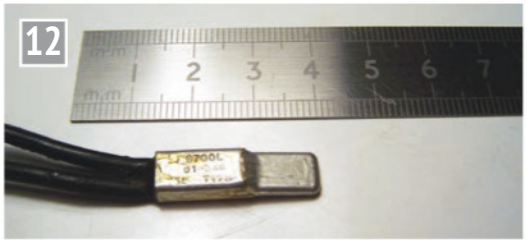
However, with the 2-pole winding, the auxiliary winding has a much higher resistance than the main winding. The 2-pole motor has roughly twice the power (and hence twice the current) so had the main and auxiliary windings been identical, a larger capacitor would have been required for the 2-pole speed. By using a thinner wire with more turns, the ampere-turns can be maintained, but the actual current required to be fed to the auxiliary winding is reduced considerably so allowing a smaller capacitor to be used. This is a very good design feature for a two-winding motor as the auxiliary winding on the 2-pole speed can draw the same current as that on the 16-pole speed. This allows the same size of capacitor to be used for both speeds. The methodology behind this design is discussed by Trickey (**ref 13**). However, the motor cannot be reversed in the same way as the 16-pole speed, as the main winding would then be fed by the capacitor and the auxiliary winding would be connected across the supply. When spin drying, the washing machine always rotates in one direction only, so this is of little consequence for its original purpose.

At this point all the non-destructive testing had been undertaken and the next stage was to determine the actual number of turns in each winding. This would require actually cutting the wires and destroying the windings. Therefore, grasping the nettle or biting the bullet so to speak (do people actually grasp nettles and bite bullets?), I carefully pulled out one section of the winding which went down one particular slot (**photo 8**). I numbered this arbitrarily as slot 1 so that I knew how the winding was originally done. This was part of the 2-pole auxiliary winding and was wound through slots 1 and 16. I cut through this part of the windings, counting the turns by collecting sets of 10 wires together and twisting them into a bunch, leaving the few odd ones as individual wires (**photo 9**). This allows an easy way of counting the turns without losing count when The Boss calls you in for lunch… (no, not Bruce Springsteen – the wife!). I also measured the wire diameter on five separate wires to get an average diameter. If all the wires are counted through every slot for both windings it would involve counting 64 separate coils, so I counted them in a few adjacent slots only until I had counted the same number at least five times. This makes it more likely that I had counted accurately. That way, if the odd wire is missed it is of less consequence when the totals are worked out.

The wires collected into bunches for counting.

The wires cut off for ease of removal.

The thermal cut-out embedded in between the windings.



The thermal cut-out itself.

I then cut off the winding close to the end of the slot (**photo 10**) which allowed all the wires to be pulled out easily from the other end. Eventually I removed all the turns for the 2-pole auxiliary winding and, having removed the inter-winding insulation, it revealed a thermal fuse embedded in the windings (**photos 11** and **12**). This is a safety feature included in the main supply to the motor (the black wires in photo 11). If the capacitor were to fail, then the motor would not start and would draw the stall current. This would, without the thermal fuse, possibly result in a fire inside the motor, so the fuse cuts off the supply should the motor get too hot. This was a self-resetting thermal fuse but, although I could determine the maker from the markings on it, it did not seem to be a device in current manufacture so I was unable to determine the operating temperature. I guessed that the temperature could have been 175 degrees C based on the marking 'T175' at the bottom right in photo 12. However, since the stator slot insulation was 0.2mm polyester film which has a temperature class of Class F corresponding to 155 degrees C (**ref 14**), it would seem doubtful that the operating temperature was as high as 175 degrees C. These over-temperature trips are readily available (search for 'resettable thermal fuse' on the Internet) and are cheap and simple. However, because the thermal fuse is self-resetting and wired directly into the motor supply, it would not trip the no-volt release on the contactor and on resetting would restart the motor. Whilst this is of little consequence in a washing machine, it would be an inherently unsafe situation in a workshop and so I decided to discard the thermal fuse and use a different type of overload trip. This will be described later. Of course, such a thermal fuse could still be used if not wired directly to the motor but kept electrically separate and wired in series with the 'Stop' button of the motor starter.

●To be continued.

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■ Elliot Mini Mill small vertical milling machine, top quality British made precision machine full set Hardinge collets single phase, substantial machine on cast iron cabinet, ideal for precision model engineer, good useable condition, £650, quick sale. **T. 01268 734589. Basildon**.

■ Clark 16mm Bench Drill, hardly used, very good condition, single phase, virtually unused, £125. **T. 01268 734589. Nr Chelmsford**.

■ Ml7 k38162/stand chucks 4jaw 3jaw drill chuck / fixed steady casting for travelling steady / change wheels (12 years use) £750. Meddings drilltru £210. Nu-Tool mill new leadscrew & nut Posilock&collet chucks £550. Ferm metal bandsaw £140. **T 0757 2892143. Grantham**.

■ New cross-slide screw & nut for 5" Harrison Lathe, older type and clutch most other bits, buyer collects. **T. 07535 301667. Stanford-Le-Hope**.

■ Myford ML7B Lathe c/w gearbox, clutch vertical slide, four jaw ind chuck, two three jaw c/c chucks, two tailstock chucks, 7" face plate, lathe carrier, 23 No2 MT Drills, 30 Reamers, 20 milling cutters, £1595 ono. **T. 07542 113567. Holywell**.

■ Fobco Bench Drill with compound cross vice, drill has seen much use hence low price, £75. **T. 01904 781832. York**.

■ Mini lathe, 4 speed, 2inch chuck, heavy metal case (40x14x11 inch) plus large wooden box containing 36 collets, tool holder, dial gauge and various other parts. £110. **T. 01372 453780. Leatherhead**.

Models

■ New and Unused 5'' gauge locomotive boilers for Sale. Both with certificates of construction and testing. Crab - Don Young design £3,500 ono. Duchess - Michael Breeze design £5,500 ono. **T. 07745 218 071. East Midlands**.

■ 5" gauge Garden Track, approx. 290 ft in mainly 8ft sections. PNP Railways moulded polypropylene sleepers, 5/8" F/B aluminium rail in plastic chairs, two hand-built points (teak sleepers). Where curved, 18ft minimum radius. £1000. **T. 01482 898434. Hull**.

Parts and Materials

■ Boxhill 5" Gauge Loco - Drawings, 8 Sheets. Laser Cut Frames & Buffer Beams. Wheels. Eccentric Straps. Hornblocks. Axleboxes. Motion Plate & Bushes. As new (Reeves), un-started project. £300 o.n.o. **T. 07740 184522. Bognor Regis**.

Magazines, Books and Plans

■ Drawings for Traction Engine 'Thetford Town' by R.H. Clark, Ami Meche, all checked and signed, drawings numbered 1-16 but 4 missing, all good and legible, £25 plus postage, also full set 'Hielan Lassie'. **T. 01915 283408. Sunderland**.

Wanted

■ Shaping machine and small milling machine. **T. 01429 281741. Hartlepool area only**.

■ Wanted to fit Smart & Brown lathe 1 3/4" 8 tpi 7" face plate ,chucks ,chuck backplates etc **T 01609 775861 North Yorkshire**.

■ 48 dp gear cutters. P.A. 14 ½ degree, number 4 and number 8. Required for my Jeremy Howell V-twin build. **T. 07845 687844. York**.

Ron Fitzgerald takes a look at the history and development of the stationary steam engine.

Continued from p.164
M.E. 4695, 15 July 2022

The Stationary Steam Engine

PART 36 – MATTHEW MURRAY AND THE ROUND FOUNDRY

The Greensand Foundry

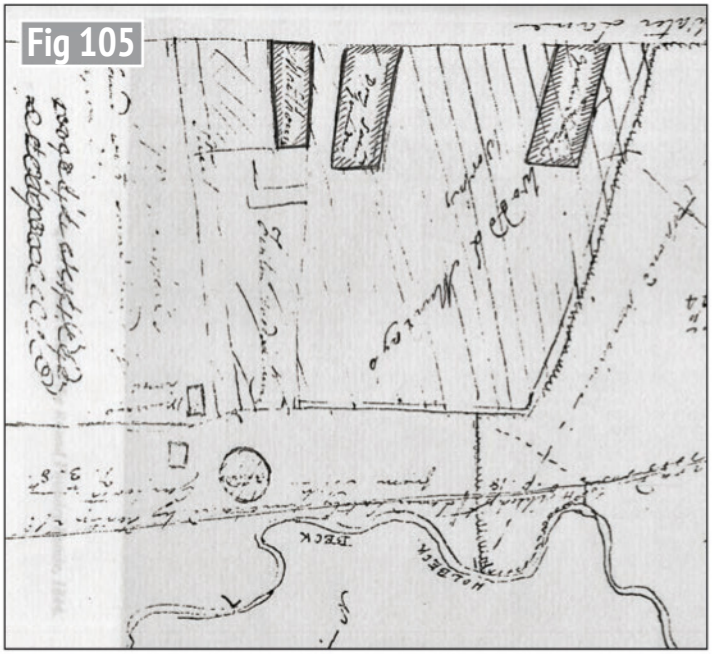
The insurance policies give an overview of the way in which the engineering works of Fenton, Murray and Wood grew in the five years following the partners' initial land purchases. The earliest policy, entered in May 1796, shows that the first building to be built was the Greensand Foundry which the later 1804 Royal Exchange policy specifically describes as a loam foundry and adds that it included a brass foundry. The next surviving policy, dated November 1798, records the erection of a second iron foundry. James Watt Jnr., writing to Matthew Robinson Boulton on the 12th June 1802, describes the two foundries standing on the site at that time. The first he says was the:

...Dry Sand Foundry ...about 20 Yards long & 12 wide with two Air furnaces & 3 Stoves, one 20 feet by 13 wide for Loam, another 17 feet by 13 for Boxes and a third, 17 feet by 9 for Cores…

The second was the:

…Greensand Foundry ...on the opposite side of the Yard about 15 Yards distant & is nearly of the same dimensions, with 2 Air Furnaces & a Cupola, which is about 8 feet high & 20 Inches Diameter but no stove, the cores being dried in those of the Dry Sand. The bottom of their green sand foundry (which is a distinct building from the dry sand one) consists for about 4 feet deep of …sand…

On the reverse side of his letter Watt drew a sketch plan that showed the location of the two foundries (**fig 105**).



James Watt Junior's sketch plan of Fenton Murray and Wood's site in June 1802.

This letter and the plan were part of a sustained campaign of industrial espionage on Watt's part (reciprocated with equal energy by Murray) which also extended to active obstruction of Murray and Wood's progress. The main reason for drawing the plan was to show ground adjoining on the east side to Fenton, Murray and Wood's premises which was owned by Peter Garforth, Marshall's close friend. Garforth, an otherwise astute businessman was duped by Watt into selling this ground to Watt's covert agent, the Leeds solicitor Upton, in order that Murray's expansion in that direction might be forestalled. (This proved to be one of Watt Junior's more futile gestures as Murray was never short of land and eventually owned more than he could use.) Also shown on the plan was the maltkiln which was then owned by the widow of the maltster, Kirby. Watt had approached the widow Kirby to see if she was prepared to rent the maltkiln to him, his purpose being to have a ready outpost from which Murray's activities could be observed. She rejected his overture.

Covert and hurried in its origins, the plan contains several errors but none materially detract from its value as a documentary source. The Greensand Foundry is shown as a shaded block at the north eastern corner of the site and the Drysand Foundry, similarly shaded, lies on the western

side, separated from the Greensand Foundry by open ground that subsequently became the works yard. The maltkiln Watt places to the west of the Drysand Foundry with what became Foundry Street between the two buildings. What was to become Marshall's main mill site in the nineteenth-century is shown as open land at the western edge of the plan with a street in front, at that time known as Peter Street but later, Marshall Street. Murray's house (Steam Hall, which has been radically mis-located by many historians) is placed close to its correct location by Watt but on the wrong side of Marshall Street. As far as the foundries were concerned, the situation shown by Watt in 1804 can be identified with that recorded in the November 1798 Royal Exchange insurance policy, immediately after Murray's second foundry was completed.

Watt must have keenly observed the differences between his own works and Murray's. In terms of the foundry capacity most obvious was Murray's complete separation of the drysand work from the loam and greensand thus avoiding cross contamination. The depth of sand in the Greensand Foundry was stated to be four feet but doubtless a deeper casting pit existed somewhere in the floor. Watt says that both foundries had two air furnaces but only the Greensand Foundry had a cupola, 20 inches in diameter and 8 feet high. The core and loam drying stoves were located in the Drysand Foundry. Because of the lack of a Murray archive it is not possible to say whether his foundries avoided the tribulations that affected Soho but the Boulton and Watt correspondence does seem to suggest that Murray's success was more rapidly achieved.

Both of the foundries survive today and after a long period of neglect they have recently been renovated for new uses (**fig 106**). The two buildings are almost

Murray and Wood's Greensand Foundry following restoration (photographed by the author in 2021).

certainly the oldest surviving foundry buildings in the world. As might be expected of structures of this age they have undergone change and rebuilding but appreciable amounts of the original fabric survive. The Drysand Foundry was converted to an erecting shop after 1860 but the Greensand Foundry was still identified as a foundry when the site changed hands in 1895 and at that time it continued to include the brass foundry. At what point subsequently it ceased to be used for casting is uncertain but by the nineteen-eighties neither building contained any foundry plant or structures. The Historic Building Survey carried out in 2003 had to rely entirely upon the building structure to interpret the features of Murray's period assisted by a limited amount of below ground archaeology.

The Greensand Foundry (**figs 107** and **108**) is a three-unit block with the foundry forming the core unit, measuring internally 51 feet in length on a near north-to-south axis and 35 feet 6 inches wide, east-to-west. Where the original wall construction survives it is identifiable by the use of hand-made brick, laid in white lime mortar. The east wall has been partially rebuilt but surviving older brickwork dating from the first phase of construction includes part of a square chimney base and a long-span firebrick arch above which is early style brickwork. The chimney was matched by a second identical stack at the other end of the arch although this was removed in the later nineteenth-century to make way for a core stove built when Number 4 Foundry was added. This pair of chimneys almost certainly served the two air furnaces that Watt remarks upon in his 1804 letter. On the other side of the wall, more recent building has obscured any signs of whatever may have existed but the first maps of the site show an outshot or shed extending between the two chimneys and it is likely that the furnace bodies were situated within this shed and hence external to the east wall. In this they would be similarly arranged to those of the Soho Foundry and also, probably more pertinently, similar to the furnaces at Low Moor Ironworks which may have acted as a direct model for Murray and Wood.

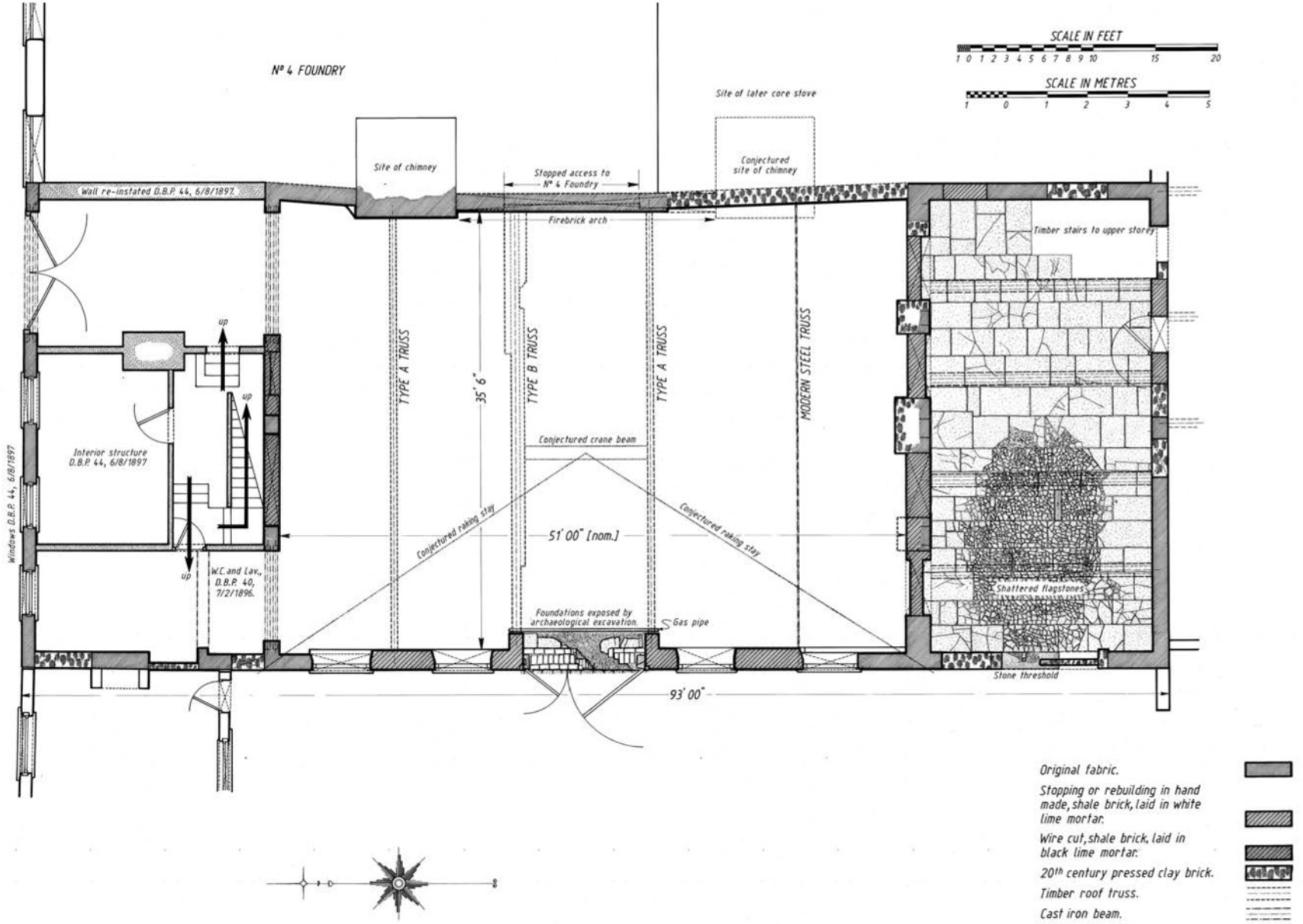
For most of the twentieth century the building was roofed in corrugated asbestos sheets but the insurance policies stated that it was slated when new - at this period Yorkshire stone flags (vernacular thackstones) rather than Welsh slates. There were originally four timber trusses (I – IV numbering north to south) but number IV has been replaced in steel. The remaining three trusses are built up from Baltic pine framed as queen-post with princess-post spans. The outer two are similar but the central one has been stiffened by the addition of a king-post and heavy timber flitches attached to the sides of the tie beam. The evidence suggests that it has acted as the support for a post crane, the top bearing pivot of which was supported by a beam spanning between the trusses II and III. This pivot bearing was steadied by converging iron tie bars that extended to cast-iron wall plates attached externally to the west wall at the outer corners. A crane in this position would be suitably located to serve a casting pit in the sand floor placed at the mid-point between the air furnaces.

The west wall of the Greensand Foundry is locally thicker by one half brick over its length between the window openings, reducing to one and a half bricks thickness at the two ultimate bays. The present double-leaf door in the centre of the elevation is recent but below the threshold the wall foundations remain in place proving that it was formerly continuous across the door gap. At the north end, the transition between the thickened section and the reduced wall section is marked externally by a significant discontinuity in the brick coursing supporting the argument that the thickened section is not original.

Two alternative possibilities may account for this increased thickness of wall construction. The first is that the stresses imposed by the crane were passed through

≫

Fig 107

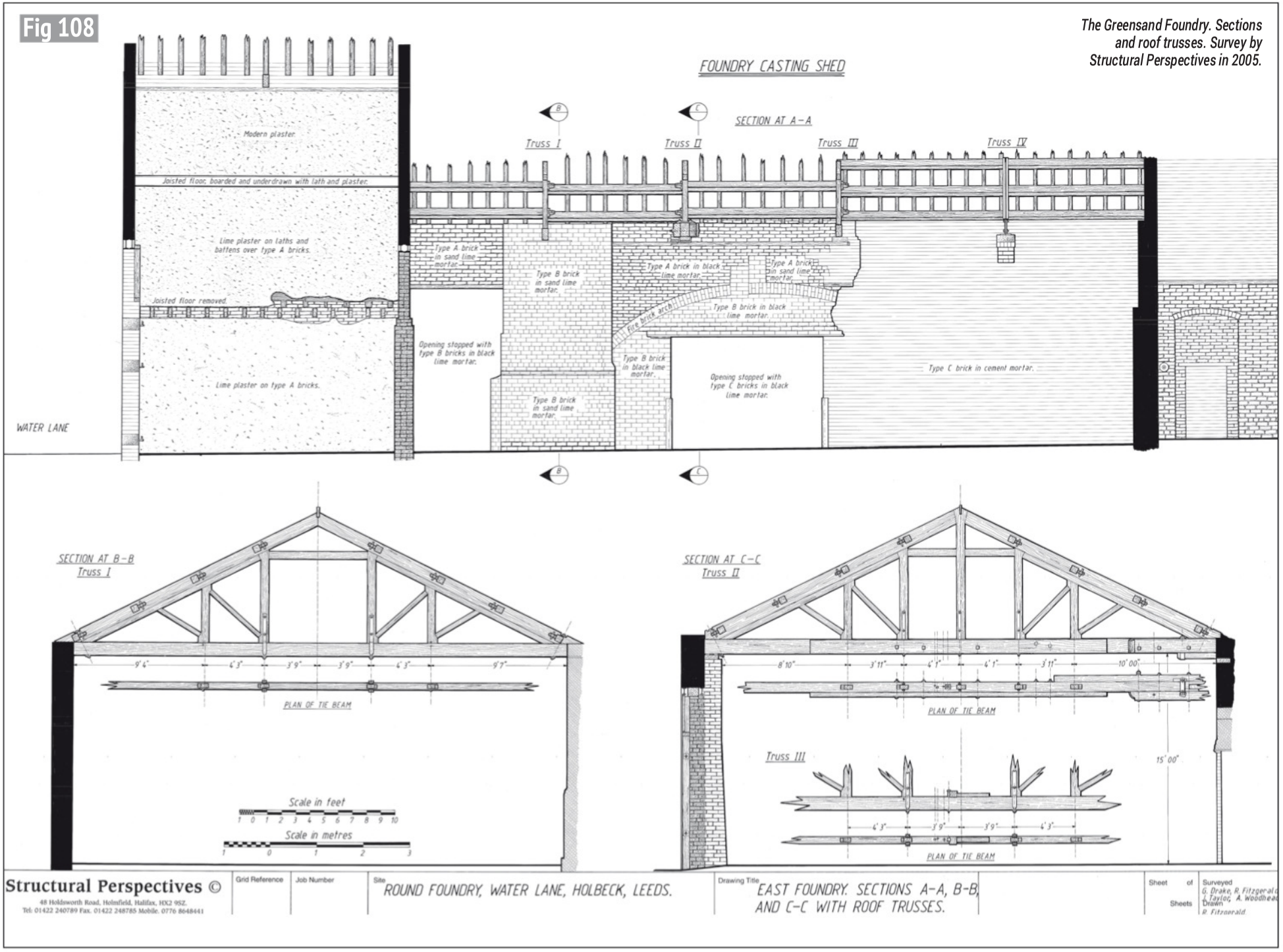


The Greensand Foundry. Ground plan. Survey by Structural Perspectives in 2005.

Structural Perspectives ©	Grid Reference	Job Number	Site	Drawing Title		Sheet of Sheets	Surveyed / Drawn
48 Holdsworth Road, Holmfield, Halifax, HX2 9SZ. Tel: 01422 240789 Fax. 01422 248785 Mobile. 0776 8648441			ROUND FOUNDRY, WATER LANE, HOLBECK, LEEDS.	Nº 1 FOUNDRY and PAVILIONS.	GROUND PLAN.		

Fig 108

The Greensand Foundry. Sections and roof trusses. Survey by Structural Perspectives in 2005.



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Tel: 01422 240789 Fax. 01422 248785 Mobile. 0776 8648441

Grid Reference | Job Number

Site: ROUND FOUNDRY, WATER LANE, HOLBECK, LEEDS.

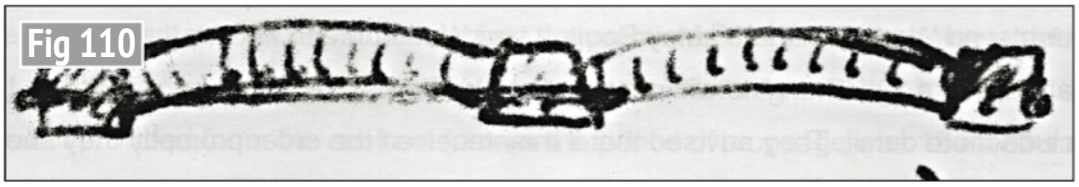
Drawing Title: EAST FOUNDRY. SECTIONS A–A, B–B, AND C–C WITH ROOF TRUSSES.

Sheet of Sheets

Surveyed G. Drake, R. Fitzgerald, I. Taylor, A. Woodhead
Drawn R. Fitzgerald

The form of first-generation fire-resisting construction used in the ground floor of this building is a distinctive innovation that places it amongst a small number of contemporaries and within five years of the first known example. That it should be confined to the ground floor of the pavilion is doubtless related to some functional purpose, the nature of which is now lost.

Peel Williams' Phoenix Foundry in Ancoats, Manchester. The left-hand building is the foundry with its open front and its furnaces.



John Southern's sketch of the brick arch and timber beam floors as used by William Strutt.

the roof trusses to the wall causing distress and the wall was subsequently rebuilt in strengthened form. The second possibility is that, when first built, the foundry was open-fronted on its west elevation towards the yard. How common a practice this was generally is uncertain but Peel Williams' Phoenix Foundry in Ancoats, Manchester, which dates from a slightly later period, has such an open front (**fig 109**).

The Peel Williams foundry building has another similarity with Murray's Greensand Foundry in that the foundry itself is flanked by pavilions. The insurance policies relating to Murray's buildings contain reference to a pattern store and a joiner's shop which are stated to adjoin the main foundry building. As will be seen from the survey ground plan, buildings are attached to the foundry at the north and south ends. The continuity of the type of brick and coursing shows these to be part of the same period as the foundry. Both have been heavily altered but relatively more complete is the building at the north end. The internal floors are reconstructed but sufficient remains to show that it originally had at least three floors and possibly four. The floors were of timber beam and floor boarded. In the past the walls have been lathed and plastered. At ground floor level there were at least two arched door openings through the wall dividing the foundry floor from the ground floor of the pavilion. This pavilion building is likely to be one of the two buildings and described in the 1796 Royal Exchange Insurance Policy, most probably the joiner's shop.

It has been previously noted that the 1800 Royal Exchange policy included within the Greensand Foundry a brass casting foundry. Brass was melted in crucible furnaces and the crucibles containing molten brass were man-handled for pouring into flask moulds laid out on the foundry floor. Although the earliest plan to show the brass casting area within the Greensand Foundry was not made until 1895, it does locate the activity at the southern end of the main foundry floor. In the present building, the wall that divides the main foundry floor from the southern pavilion incorporates three flues that have been removed at the lower level but remain *in situ* above. Below-ground archaeology confirmed that these flues related to brass melting furnaces.

Between each of the flues there were four arched openings into the south pavilion. The upper storeys of this pavilion were removed following a fire but the remains indicate that there were at least two storeys above the ground floor and that the second floor was of conventional timber beam construction with bridging joists and floor boards. The structure spanning over the ground floor adopts a different pattern of construction. In a previous part of this series, the earliest history of fire-resistant industrial buildings was described in connection with Marshall and Benyon's Ditherington Flax Mill. After Marshall's B Mill had been destroyed, in an unusually amicable gesture, Lawson showed Marshall a sketch by Southern (**figs 110** and **111**) of the fire resisting floor system used by William Strutt in his factories at Milford and Derby. In Southern's words the system involved:

...throwing brick arches between beam and beam somewhat thus and tying the beams together by iron bolts to prevent them from yielding to the (force of the arches)...

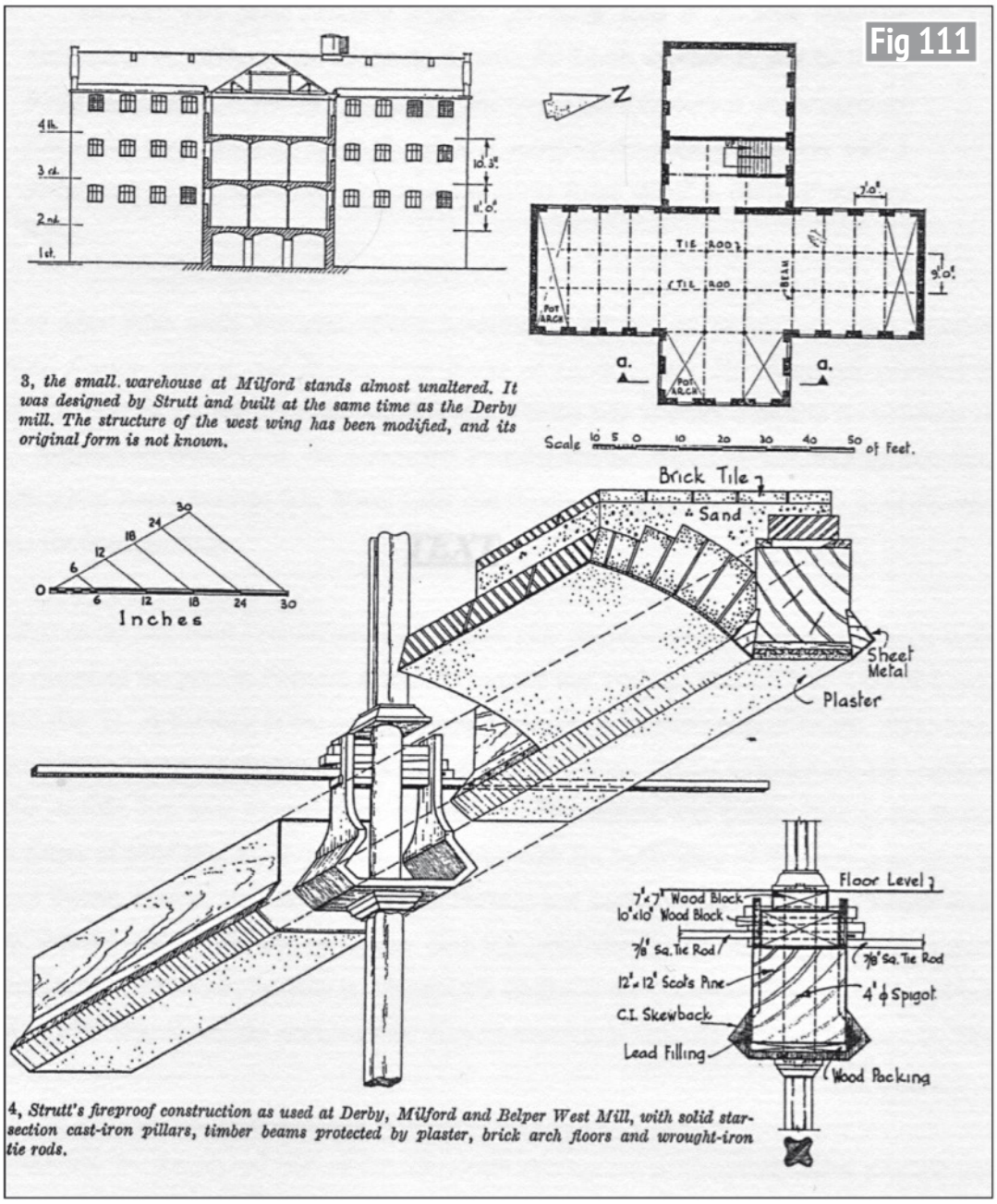
Southern's letter was written in February 1796 and Murray's Greensand Foundry with its pavilions was sufficiently complete to be insurable by May 1796. The suspended floor over the pavilion's ground floor included Strutt's method of construction using timber beams and brick arches. At some point in the past the brick arches have been removed but the timber beams remain with the skewbacks which supported the arches. Traces of the brick arches can be seen in the brick wall between the

beams and the wrought iron tie bars between the beams are still in place (**fig 112**).

The form of first-generation fire-resisting construction used in the ground floor of this building is a distinctive innovation that places it amongst a small number of contemporaries and within five years of the first known example. That it should be confined to the ground floor of the pavilion is doubtless related to some functional purpose, the nature of which is now lost. One possibility is that it formed the earliest core stove. It has previously been stated that Watt Jnr. had placed the core stoves for both the Greensand and the Drysand Foundries in the latter building but the Greensand Foundry was in operation for two years before the Drysand Foundry was completed. It must be assumed that over this period any cores that were required by the earlier foundry were dried in some alternative stoving facility and it may be that this fireproofed chamber served that role.

Possible supporting evidence for this theory is to be found in the four arched openings that communicated between the main foundry floor and the pavilion ground floor. These would facilitate the transfer of cores between the two sections of the building but more particularly with the area used for brass casting which used cores most extensively. It is also notable that the floor of this chamber was laid in Yorkshire flagstones and in the west wall a large doorway opened into the yard, with an early cast-iron lintel spanning over. The traffic through this door opening must have been heavy, possibly involving iron or iron-shod wheels, as the flagstones were shattered in a fan pattern radiating over the western half of the floor. This could well be related to the use of the chamber as a stove. Core stoves construction will be discussed more extensively in connection with the Drysand Foundry.

●To be continued.



Skempton and Johnson's drawing of the Strutt fire resisting floor system.

The remains of the fire resisting floor in the South Pavilion of the Greensand Foundry. Survey by Structural Perspectives in 2005.

Roger's Ramblings on Measurement

PART 1 – CHAINS ARE FOR DRAGGING THROUGH BUSHES

Roger Curtis gets the measure of the countryside.

I can't quite remember how it came about but I think it was something about the length of a cricket pitch. Anyway, some time ago, at the Guildford Model Engineering Society's Rally, I found myself explaining to one of our French members all about acres, furlongs and chains. He seemed very interested and remarked how logical it all was - he even made notes. Others who were there also appeared interested and it occurred to me that it could form the basis of this article in which I ramble on about my thoughts on length measurement in general.

There is quite a lot that I would like to say so I have divided it into two parts. In this first part I will just ramble on about the old methods of land measurement and how convenient they are to use. In Part 2, I will get a bit contentious, discuss what I see as the two major flaws in the metric system and muse about what might have been.

But before I begin let me make it absolutely clear that I have no desire whatsoever to change things. Like most engineers of my generation I was brought up on the Imperial system but have had to change over to the S.I. (metric) system of units. Most of this change occurred during the time I was teaching surveying and civil engineering and I now consider myself multi-lingual in measurement units and generally use whatever is most convenient at the time. However, as we shall see later, there is one application in which I would never even consider using anything but the old Imperial units.

So, let's start at the beginning with what I was explaining at the rally. As most of us know, a cricket pitch is 22 yards or 66 feet long, which in land surveying terms is 1 chain. Now 10 chains is one furlong which is about as long a furrow that a horse and man can plough before they need a rest. And if we take a plot of land that is a furlong long and a chain wide we have an acre which is about as much as a man with a horse can plough in a day. A couple of simple sums show that an acre is 10 square chains or 4840 square yards.

Those who go horse racing will know that eight furlongs is equal to 1 mile which means that 1 square mile is equal to 640 acres.

But there is more. A chain is made up of 100 links and 25 links or ¼ of a chain (5½ yards) is one rod, pole or perch, which is another land measure which is still used. I have an allotment on which I grow vegetables and even to this day my annual rental demand refers to it as being of '10 rods or thereabouts'. That is 10 square rods which is about 300 square yards. This is the traditional size for an allotment and is enough to keep a family in vegetables all the year round. Those of you who are good at sums will have worked out that there are 160 square rods to the acre.

Now let's go back to the chain. The surveyor's chain, or Gunter's chain, after its inventor in 1620, is, as you would expect, 22 yards long, it is made up of 100 links and is similar to the one shown in **photo 1**.

The links are typically made of 10 or 12 gauge steel wire. It has brass handles with swivels at each end and there is a tag at every tenth link. The round one is at the centre and the others have points indicating the number of tens of links from the end – so the two three-point tags are each 30 links from one of the ends.

The surveyor's chain is a very clever and extremely easy to use measuring implement; it can be dragged through bushes and streams and is easy to read even when covered in mud. It also lends

A measuring chain.

itself to a very simple way of surveying the vast amount of detail that needs to be included on a map or plan though there is not the space here to go into the details of the process. These days we have air photographs and GPS and the chain surveying process is largely forgotten.

You may think that a link that is 7.92 inches long is somewhat inconvenient but this is not so. The largest scale at which the Ordnance Survey produced Imperial maps was 10 feet to the mile which is 1½ inches to the chain or 1:528. (The largest scale modern maps are 1:500.) At this scale one link is 15 thousandths of an inch (0.4mm) which is about the width of a line on the plan so to survey detail, such as the positions of buildings and fences, to half a link is definitely good enough.

The old civil engineers so liked the chain as a practical measuring device that they invented their own version in which each of the 100 links was 1 foot long (that shown in photo 1 is an engineers' chain). On linear civil engineering works like roads, canals and railways the location of any feature was and is referred to as its 'chainage'. So, a bridge that was located some 1563 feet from the nominal beginning of the job was referred to as being at chainage 15+63 i.e. 15 engineers' chains plus 63 feet. When metrication came in there was a move to use the term 'metrige' instead but this never really took off and to my knowledge the term 'chainage' is still used in the UK even though the distance is measured in metres.

With metrication came metric chains but there is a problem. How long do you make a link? Clearly to make them 1m long is just not practical and a chain with 100 links of 1mm will not even go around your wrist! Even resorting to centimetres which are not a preferred SI unit does not work. Metric links are therefore 200mm long, which is close to the length of a link on a Gunter's chain, but it means that you either have to divide the link count by five or double it and divide by ten to read a distance.

It gets worse. Though 100 link (20m) metric chains are available it was decided that it was a bit short for engineering purposes and would be better to have one of a similar length to the engineers' chain (30m) and for this a metric chain needs 150 links. To fold and hold a 150 link chain needs the hand and strength of Goliath. Furthermore, if you drop it, which is very likely with so many links, it can become tangled and believe me you do not want to have to try and sort out a tangled surveyor's chain, especially one with 150 links.

This brings me to what I see as the two fundamental flaws of the metric system. The first is entirely down to the French (apologies to our French colleagues), though as we shall see there are very sound and logical reasons for doing what they did, and the second is down to human anatomy. I will ramble on about these in the second part of this article.

●To be continued.

THE BUILDERS

My next-door neighbours were having some work done on their house and I could not help but overhear two builders discussing a problem whilst working on the roof. They had clearly taken several measurements and were using expressions like 'twelve fifty', 'fourteen hundred' and 'two fifty'. When they had resolved the problem one of them said "Right oh, I'll go and get a bit of six by two".

The Imperial system is clearly not dead.

Britannia Class 7 Locomotive in 5 Inch Gauge

A Modelworks Rebuild

PART 13 - PAINTING AND DETAILING

Norm Norton takes a renewed look at this popular, kit-built BR Standard Pacific.

Continued from p.136
M.E. 4695, 15 July 2022

We make prototypical engines and hope that what we finish with might be a reasonable representation of full size.

The finished model

This is the concluding article in this series. The model of a BR Standard Class 7, 70013 *Oliver Cromwell* is now finished and it passed its club hydraulic and steam tests in March 2022. Now, I finally play with it and draw a line under hours of enjoyable construction, but also some stress at times when things went wrong.

I purchased the slightly tired looking Modelworks engine three and a half years ago, I have spent 25 months of regular five or six days-a-week work in that period (thank you Mr. Covid) and the diary records 550 days spent. If we say six hours for each day, that is 3,300 hours. And all for a rebuild!

I am pleased and happy to say that it is a Modelworks engine underneath and I chose to keep its original given number and name. The only Modelworks parts left are the heavy bits: frames, wheels, cylinders and motion parts (all recut and shaped), smokebox and deflectors, plus the boiler. Almost everything else you see is new build.

Photographs 134 to **138** show the model and **photo 139**

The window frames are made from two sections of brass held together with 14BA CSK screws. 1mm thick glass is sandwiched between the two frames. The sliding side windows are also glass and edged with mahogany laminate.

In their day, Britannias would have had all the pipework below the running plate painted black. I have taken a small 'builder's liberty' by leaving it in bare copper, just as the full size engine is today.

shows the real, 'big' engine in 2019. I have been fortunate in having this full-size engine available to see. If we make a prototypical model then we hope it might have a feel of the real thing when it is finished and I am reasonably happy that this one does. I confess now that the painting of my model is not strictly 1950s BR Standard; yes I have made all the top pipework green but the under-cab pipework should all be in black (**photo 140**). I have chosen to leave it in copper; it does lift the appearance and I am using the excuse that it does look like *Cromwell* today.

The line of the boiler and cab at the top has come out well but the cab does sit too high as the firebox is 12mm too tall (photo 138) – I can't do anything about that. It was deciding to make the Hewson cab that upset my plans for a simple and quick rebuild of this Modelworks engine. Once I saw it finished with all the rivet detail I knew I would have to continue the rebuild to the same standard or be unhappy with what I had made.

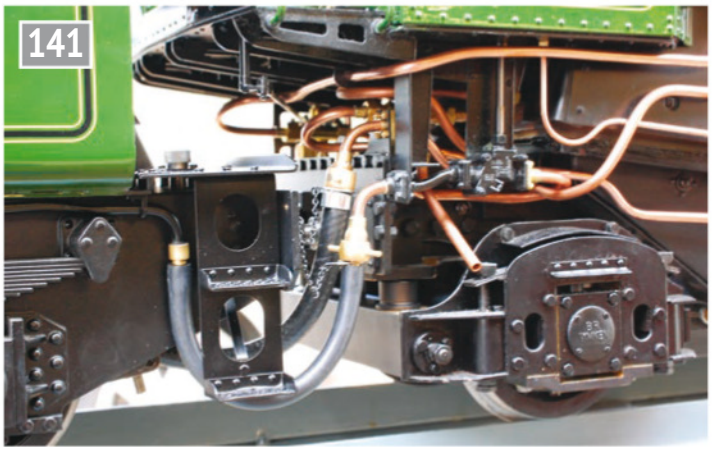
A characteristic of a BR Class 7 is the boiler line rising to join the firebox, then falling before meeting the cab.

The Metcalfe exhaust injector (photo 136) is a dummy but water from the tender hand pump feeds through it and on up to a top feed clack. The two injector steam valves in front of the cab are worked by universal joints and they feed the left and right model injectors that are hidden beneath the cab floor.

The black rubber water supply pipes in **photo 141** use screw-on couplings to connect to the engine. The nature of the bend is exactly as per prototype; it copes with

The tender tank is held onto the frames by just four central 2BA studs. The brackets where it meets the buffer beam are dummy.

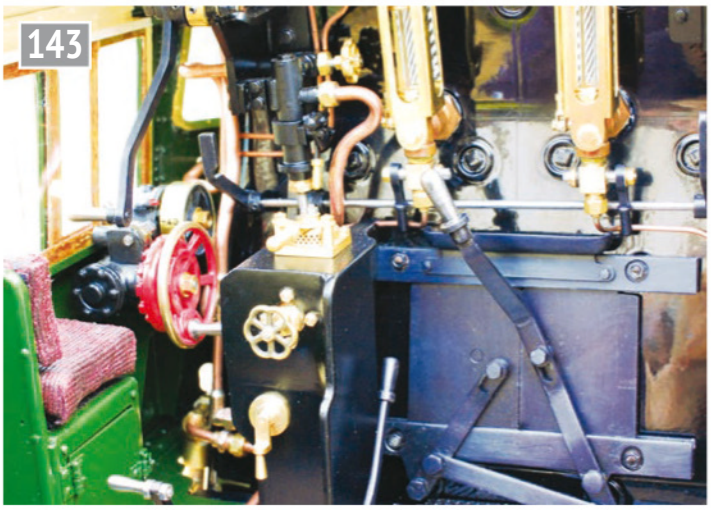
Above is the real Britannia in 2019. Compare this to the model in 2022 in photo 134. Not quite the same viewing angle, but they do feel related.



The tender water pipes attach to the engine by prototypical spin on couplings, with an O-ring providing the seal. The small chains stop the pipes falling in the dirt when the tender is uncoupled.

The steam pipes feeding the valves are wrapped in thin cotton shoelace, sealed with PVA and painted. The valves are operated through universal joints and the steam is delivered to working model injectors under the cab floor.

The interior of BR Standard cabs was black and not green. Not many ceilings would have stayed off-white for long.



The firebox doors have been 'chemically black' treated. Britannias did not have red reverser handwheels, although some 9Fs did.

flexibility and the couplings are simple for two fingers to spin on and off. The higher connection behind is from the tender hand pump. It uses heavier wall fuel injector hose and the ends are connector crimped. The little chains stop the pipes falling down into the dirt when the tender is disconnected.

Below the cab in **photo 142** is a dummy 10X injector, but the model injector does feed through this and up to the left hand top feed. The often quoted need for 'short and easy feeds for the injector' are not strictly to be believed; it is working fine at the moment.

The cab shell lower interior in photo 142 is green but I think the standard should be black. The driver has been treated to foam cushions with waxed material covers (**photo 143**). We will see what happens when a piece of burning coal lands on them! **Photographs 144, 145** and **146** show further details.

LEFT: This is a driver's eye view. There is easy cab access with the large tender bulkhead insert removed. The tool tunnel adds interest, without getting in the way. The footrests are on the tender which means that I can work all the controls by hand, but a small handle makes operating the reverser much easier.
RIGHT: With the cab roof and bulkhead insert in place you would have fun trying to fire and drive this!

Commissioning

Commissioning is a word often used for making built machinery work and in the case of small engines it is not an insignificant task. Once painting and reassembly was finished I had the job of finding out whether it was leak tight. A few pipe connectors had to be sorted out; one water valve did not flow and the whole pedestal had to come out as the previously tested steam brake valve now decided it liked leaking all the time. The water gauges also gave me problems and next time I would do things a little differently.

I sorted out its working with compressed air for the big leaks, then hydraulic tested and steam trialled at home. I arranged for fifteen feet of track by linking two trollies and was mightily relieved to find that the PTFE head piston valves did not bind and that the industrial stainless and PTFE regulator ball valve I have found worked

It looks nice, but there are some problems here with tender and cab alignment caused by the boiler height and an over-long drawbar.

Preparing the engine in Gilling East steaming bay. (Photo, Mike Lock).

The track is fully signalled which makes it so interesting and needs concentration. Sometimes you are stopped long enough to be able to take a photo.

About to set off for its first trip to collect a train from the yard. One of the signals will drop to show the road is set.

perfectly - I was able to run the engine forward and reverse, with drain cocks open, up and down the fifteen foot. A very satisfying session. Next day, another steam test and another hydraulic to find out what had opened up - and then the Club official test a few days later when I knew all was good.

Just a week after the official steam test I had the great fortune to be booked into a weekend GL5 Club event (**photo 147**). This was at the kind invitation of Ryedale SME who run an outstanding track in the village of East Gilling, not far from the North Yorks Moors Railway.

This five-inch *Oliver Cromwell* performed excellently over three days, being in steam for around ten hours and covering nine miles pulling a variety of trains (**photos 148, 149** and **150**).

I have no problem in telling you, also, what went wrong, including:- a bogie wheel coming loose from its axle, the front bogie being too lightly loaded causing worsening derailments, various minor pipework steam leaks that came and went, driving truck seat broken and the valve timing has moved somewhere as she would not notch-up and sound correct. I am also unhappy with the prototypical length of the tender front buffers (photo 145) – they require that you fit an excessively over-length drawbar to prevent them going solid on tight curves and throwing the bogie or tender off the track. I am going to cut those buffers right down!

All these jobs are to do now we are back home. The injectors worked perfectly, the fire was kept just about right by the exhaust draw and even the steam brake worked. The regulator was a delight to use. These are the key things that make an engine pleasant to drive.

Once you have experienced ground level driving, with true rolling stock, working timetables and full signalling, I am afraid that, for me, going round in circles on a raised track just does not have the same appeal.

The tender now has coal dust and bits in it, the cab is filthy from ash rising through the fire door after disposal, the paintwork spotted with oil and water stains and oil is dripping from the motion. I am pleased that I just escaped the emotional trap of thinking 'this is too precious to use and get dirty.' But should I have spent so much time turning a Modelworks engine into a better looking example? Well, I am very content with it, it gives me great pleasure and that enjoyment will continue by using it and not putting it in a glass case.

I want to acknowledge and thank the following people: Doug Hewson for his earlier series of articles in *Model Engineer* on this same subject of a Modelworks upgrade – he gave me much inspiration; Geoff Watts of Northampton SME whose generosity to the club resulted in me purchasing this engine and Chris Orchard, a colleague who helpfully sowed the seed that resulted in my writing this series.

ME

I am indebted to 'Thompson Locomotive Engineering' for this image and for posting the video film on YouTube (search GL5 Spring Event 2022). The engine has a nice exhaust note, that I am pleased has worked out, and the sound of the Mk1 coaches over the rail joints is wonderful! And, yes, apparently BR did run milk tankers behind express passenger trains, but my apologies for still having a light engine head code displayed.

Drivers eye view of the approach to the tunnel on the ground level track.

The impressive footbridge over both the raised and ground level tracks.

The 2022 Sweet Pea Rally

John Arrowsmith finds that Sweet Peas are flourishing in Fareham.

This year the rally was again held at the Fareham Society of Model Engineers in Hampshire (**photos 1** and **2**) and they are the first club to have held it four times. The weather forecast for the weekend was good so I was looking forward to an interesting weekend with lots of good running and exchanges of ideas and comments.

The Fareham Society is very fortunate in owning their own site and, as they explained to me, everything you see when you enter the ground belongs to the club - there are no outside interests to complicate the running of the society. These days, to have that sort of security is a very favourable position to be in and gives the committee the confidence to plan ahead.

When I arrived on Saturday morning there was a buzz of activity about the grounds which augured well for the weekend. However, it turned out to be a little disappointing for the club because the attendance was down from previous gatherings, probably because of the high cost of travelling these days, but nevertheless those that did attend had a very good weekend. At these events the steaming bays are always the place to be early in the day and it was no exception this time, with a number of locomotives being prepared and steamed.

Usually, there is an unwritten competition to see who can be first on the track and unsurprisingly Malcolm High maintained his record with his familiar *Adele Marie*, an 0-4-2 tender version of the 'Sweet Pea' model which was taking the track in its stride (**photo 3**). Malcolm was quickly followed by Chris Ball from the Nottingham SMEE (**photo 4**) who was again making it look so easy. However, Chris is a regular fireman on the full-size locomotives of the Great Central Railway at Loughborough, so if he couldn't get his locomotive going well then the rest of us didn't have much of a chance! The only 7¼ inch gauge locomotive in steam was the regular performer *Jacquie O*, an 0-4-2 version of the design

A happy Malcolm High leaves the station to travel round the circuit.

Chris Ball from Nottingham runs past the steaming bay with Ernie *steaming well.*

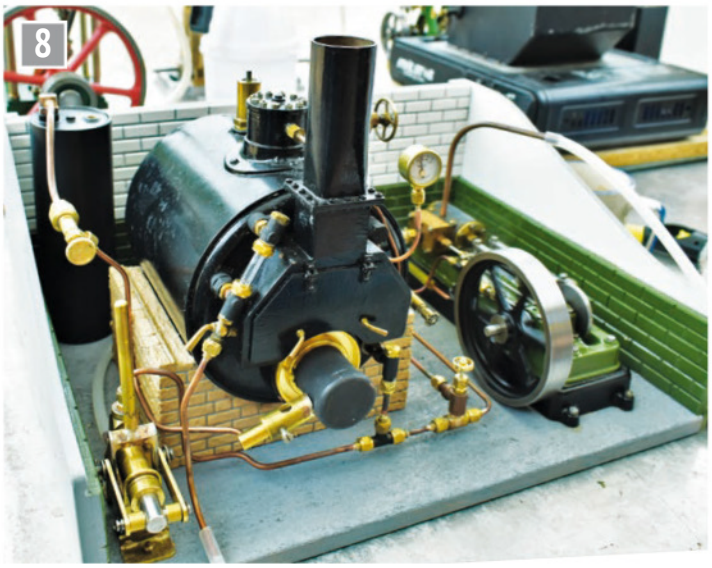
The small display of working stationary engines in front of the clubhouse.

A detailed Cross Engine built by Charles Read.

Phil Owen from Blackgates slows to stop in the station.

(**photo 5**) owned by Phil Owen. This engine was in steam for the greater part of the day and a number of other drivers were given the opportunity to take the regulator. It is an excellent engine to drive and performed well on the Fareham track.

Away from the track the hosts had put on little display of stationary engines which were all very well made and added to the overall atmosphere. A nicely made Cross Engine was the work of Charles Read and was quietly working away powered by a small boiler plant that Chas



The boiler plant owned by Brian Fisher.

≫

The 1930 Austin 7 owned by Clive Addis has been in the family for 85 years.

A double electric version of the engine owned by Phil Brien from the Fareham club.

An excellent little 'Sweet Violet' 3½ inch gauge version of the engine.

Brian Holland from Oxford concentrates on the line in front with his 0-6-0 Metre Maid Fair Rosamund.

picked up second hand, not knowing what condition it was in. However, it was cleaned up, tested and passed all the required conditions and here it was powering his engines (**photos 6** and **7**). Adjacent to this set-up Brian Fisher had his small boiler plant (**photo 8**) working away powering a well-made Steeple Engine. A couple of other interesting exhibits were on the site, one of which was a 1930 Austin 7 motor car (**photo 9**). It was bought by the present owner's grandfather and Clive Addis told me that it has been in the family for 85 years. He personally renovated it to the condition it is in today about 40 years ago, so you can see from the photograph what a good job he made of it. Compared to the modern car it has remarkably few refinements. For example, the petrol is gravity fed from a tank in front of the passengers, the shock absorbers are made of wood and apparently are useless in wet weather. When Clive tried to replace the tyres he had to wait for sufficient numbers to be required before they could be made. There are no door locks and the advance mechanism in the distributor can be adjusted from inside the car. It seems motoring in those days was a lot less complicated than it is today.

One of the more unusual locomotives on site but not in steam was the Mallet style electric 2-4-4-2 of Phil Brien, a Fareham club member. This engine always creates a lot of interest when it is on show (**photo 10**). Alongside it was a nice little 3½ inch gauge 'Sweet Violet' version of the design (**photo 11**). I don't know who built the locomotive but it was well made and had a very solid looking appearance.

Meanwhile three generations of the same family were enjoying their track time. Regular attendee Brian Holland had his 0-6-0 'Metre Maid' running well (**photo 12**) and with him was son Paul (**photo 13**) and grandson Martin (**photo 14**), who were making the most of the excellent track at Fareham. The raised track itself is about 450 metres long and such is the layout that with the 7¼ inch gauge track running round the outside, four lines come together in one part of the site so that four trains can be side by side all appearing to go in different directions but in fact are all proceeding towards the main station.

Other locomotives going well during their time slot was the 5 inch gauge *Sweet Jay* from the Hereford SME driven

Paul Holland with Fair Rosamund *powers up the long middle straight.*

Young Martin Holland is pleased to be driving grandad's engine as he leaves the station.

Nigel Linwood from the Hereford SME crosses the fine string girder bridge towards the station.

Peter and Chris Harrison prepare their engine for a run on the track.

Martin Everitt from the Isle of Wight steams his engine for his first run.

Jacquie Owen presents Malcolm High with the winner's Tee shirt and trophy with the original Sweet Pea *in the background.*

by Nigel Linwood (**photo 15**). *Lathyrus* is the Latin name for 'Sweet Pea' and this was the name of the engine being driven by Peter and Chris Harrison from the Reading SME (**photo 16**). The activities carried on during Sunday morning with an additional locomotive brought by Martin Everett from the Isle of Wight (**photo 17**) taking an active part in the proceedings.

The sponsors for the event are Blackgates Engineering who provide The Jack Buckler Memorial Trophy as a reminder of the originator and builder of this very popular locomotive. This year the very nice cut glass vase was awarded to Malcolm High for his contribution to the rally (**photo 18**). That little ceremony signifies the formal end of the rally and I would like to thank all the members of the Fareham Society for their excellent hospitality and welcome. I am sure everyone enjoyed the facilities and the 'on tap tea and coffee' with biscuits on both days. The ladies of the club as usual worked very hard to ensure everyone was fed and watered. Finally, thanks to Peter Holland from the host club for his organisation.

Next year's rally will be held at the Sheffield & District SMEE at their Abbeydale Road site over the weekend of June 3/4 2023. I hope to see you all there.

ME

CLUB NEWS

Geoff Theasby reports on the latest news from the Clubs.

GH&J locomotive (photo courtesy of Chris Robinson). INSET: GH&J rail ticket, Visby.

The prodigal returns after 1000 years!

One of the destinations of our cruise was Visby, in Gotland, a large island off the Swedish coast. Our guide was local and pronounced it Veesby, Obviously, I picked up on this, due to the phonetic similarity with my name, which is thought to have originated in Wensleydale, North Yorkshire. One may speculate that incoming Vikings named their settlement after their birthplace, as did later emigrants to Oz and NZ, Canada, New England etc. Discussing this with her she said, "Welcome back!"

As I would concurrently be on a separate tour of the town of Visby, I despatched Chris Robinson, a fellow passenger and ferroequinologist, my temporary, acting, unpaid amanuensis, to take notes on the Gotlands-Hesselby Jarnvag, or railway, which he would be visiting on a different tour. He was somewhat disappointed to find an 0-4-0 Diesel locomotive, which powered them along 8km of track and returned. It runs on the trackbed of the old Visby Railway - more power to their elbow - but it is off the tourist trail. A steam locomotive *Dalhem* is 99 years old, delicate and temperamental, so does not run frequently. Chris gave me his Edmondson ticket by way of a souvenir (**photos 1** and **2**). See forening.gotlandstaget.se/english/

I noted many cobbled streets in Tallin and Riga, all clean and well maintained, as were the trams, this one for instance (**photo 3**). In Stockholm, moored near the VASA museum, is M20, a minesweeper from 1941 – 2005, now a museum ship, and approaching Riga we passed the Coal Terminal - lots and lots of coal train sidings full of bogie hopper trucks. Only one locomotive was visible, a small yellow shunter, almost lost among them. This may have been their German DER100, a radio controlled, unmanned shunting 'robot' by Vollert. On our way through the Kattegat we met a Royal Navy Type 45 destroyer which was trailed by a much smaller ship, which may have been its Russian 'trailhound'. A fellow passenger said it was 'not a Type 45' but no other ships have a similar outline, two large masts, with a spherical radome on the forward mast and a larger

A Tallinn tram.

'rotating bedstead' on the rear. There were also exercises being conducted in the area - some heard 'popping noises' - but nothing to worry the good ship *Balmoral*. Wandering the streets of Riga and Tallinn, the conflict around the Black Sea seemed very far away but our guides left us in no doubt as to where their sympathies lay.

In this issue, misbehaviour, a video, steam wagons, auction lots, an N2, a crafty smoke, a printing press, Welsh as she is spoken in NZ, Deltic bogies, a coal fired G1 and turbine locomotives.

In the Sheffield Auction Gallery of 24th May there were a few items of engineering interest: several Mamod vehicles all under £100, two ship models, one a Mississippi stern-wheeler, which brought £70, a fairground Gallopers est. £3K, Clayton undertype without the flatbed est. £3K and several other mechanical models.

On a **Sheffield Society of Model & Experimental Engineers** running day, I was admonished for crossing the tracks where I shouldn't have and rightly so. I should have known better; I am very sorry, guys!

Their May *Steam Whistle* bears a photograph of Jake Lofthouse and his automatic, working, level crossing intended for garden railways. Very good young sir! Mike Peart writes on matters of time on the GWR. Murray's Thoughts are with the excellent versus the everyday, with special attention regarding the NHS. Are hundreds of small operations better than one heroic and expensive project? Robotic surgery, shall we say, requires computing experts, surgeons, modern drugs and scanning facilities all coming together at great expense. An enduring memory is the sight of a trainload crossing the bridge, eight adults, each with a small child in front of them, looking for all the world like a set of chess pieces. The June issue features Mike Gibbs leaning nonchalantly on the *Duchess of Sutherland* (the locomotive, not the noble lady) in the absence of an invitation to meet HM the Q on her Jubilee. H. Maurice Turnbull describes a Victorian plank sawing machine, patented in Holland in1592, but the concept was described by a French engineer in c.1250.
W. www.sheffieldmodelengineers.com

Robert McLuckie sent me a lovely video about their new site, an excellent documentary called *The Model Engineers* about **Edinburgh Society of Model Engineers** in their new site at Almondell Woods. It is a well presented, serious illustration of a good miniature railway. The maker, Kris McAlpine, is by profession a software engineer and this is his hobby. See YouTube: 'The Model Engineers', and the club website.
W. www.edinburgh-sme.org.uk

Right, Tally Ho! In no particular order, *Raising Steam*, from the **Steam Apprentice Club,** part of the National Traction Engines Trust, features a crane engine, a Fowler B6 from 1928. Kate Plant writes on the Weeting driving day, illustrated by many of her pictures. The Archives were trawled again by Elisha Bell, covering various steam wagons, including a Foden undertype with side tipping trailer, the same company's 1029 J type, in the form of an articulated 6-wheeler, a 1928 type K 6-wheeler and a 1930 Foden C-type tar sprayer. Rivalling Christopher Vine's 'Peters Railway' books for young enthusiasts are Wendy Wakelin's 'Victoria's Torton Tales' which cover life with a traction engine. This is followed by another in the Unusual Engines series, this time a Sentinel Roadless tractor, a form of half-track. A brief video is on YouTube.
W. www.ntet.co.uk/sac

Teesside Small Gauge Railway sends *Trackerjack,* May, in which we learn that Nick's *Brigit* takes 30 minutes to prepare. 10 minutes to get the fire going and 20 minutes to polish the steam dome!
W. www.tsgr.co.uk

The Frimley Flier, May, from **Frimley & Ascot Locomotive Club**, has Paul Naylor buying an old printing press for £50. In the interval between agreeing to buy it and collecting the item, he found that it was probably seized, weighed ¾ ton, was in an old cellar, accessed through a shop and with narrow, steep stairs. His trailer, meanwhile, only had capacity for 350kg. The press appears to be a 'Minerva', made in Nottingham in 1870. Paul says that in good working order they fetch £2,000 but it is definitely a niche market.
W. www.fmlr.org

Worthing & District Society of Model Engineers summer edition opens with the headline, 'You never know...'. Their running day featured the lucrative 'hire a fishing rod and catch a prize' pond for the children and unexpected guests were Liz Groome and her sister, Rebecca, both qualified steam drivers from the Bluebell Line. Their father John was once a Worthing club member. Secretary Dereck Langridge reports an excellent response to his lamentations of a biscuit *shortcakeage* and now has lots of McVities products to assuage the inner Dereck. He also resurrects a verse what he had writ many years ago, ending in 'Marriages are made in heaven it's said, but they last so much longer if you've got a SHED!'
W. www.worthingmodelengineers.co.uk

Our motoring correspondent, Pete Oilysaga, out and about in the Shires, spotted a bus being mended at the roadside, in the rain, where an employee improvised a shelter from the engine cover. An unusual sight on the M1 was a van pulling a trailer made from the

G3 gunpowder van (photo courtesy of Ted Sadler).

rear half of an identical van and painted to match, and a car with CYMRU on the back, which Deborah tells me that at school in 1960s NZ, was always pronounced 'Simroo' because none of them had ever been to Wales, nor indeed the UK.

A 56 page glossy magazine, the **Gauge 3 Society** newsletter, summer, features Jim Clement's newly-completed N2, a 2-6-2T which made its debut at the Flitwick GetToGether. Roger Marsh was offered a Kingscale 0-4-2 autotank, 'with a few problems' - an accurate description... Mark Pretious built a Longmoor Military Railway 0-6-0 ST whilst John Branch makes a pair of 1920 District Line F Class underground carriages. Barry C. Lane scratch built a LNWR Jumbo and this gunpowder van caught my eye (**photo 4**). Photographer Ted Sadler declines to comment on the pairing of WWI soldiers with a WWII vehicle…

W. www.gauge3.co.uk

Hereford Society of Model Engineers' *Whistlestop*, May, includes an item about editor Martin Burgess's 'other woman', a sailing boat. Six tons of teak, oak and spruce, which should burn well on Nov 5th (sorry Martin! - Geoff). John Arrowsmith reports on the Federation of Model Engineering Societies AGM and in the Polly Engineering award for Young Engineers top prize went to Hereford (Matthew Kenington) and third and fourth places as well. My congratulations to them all. I am also rather taken with Tom Williams' Pedalino, a chain driven 7¼ inch gauge track cycle which is also electrically powered, if I correctly understand the photograph. An article about Sheffield's Kelham Island Museum was prompted by Richard Donovan's attendance at the National Handbell rally, held at the city's Victoria hotel in April. Chairman Wally Sykes made a magnetic chuck, writing it up, and John L Townsend discusses 'rosebud grates'.

W. www.hsme.co.uk

Skegness?

High Wycombe Model Engineering Club's *Criterion*, June, bears a picture of a WHR Garratt, NGG16 No 87 standing at Beddgelert, "Why?" you may enquire, and reasonably so. However, member Martin Page is continuing his series on the railway by taking a look inside the locomotive cab and the functions of the 'shining taps and levers'.

W. www.hwmec.co.uk

Today June 23rd, the **Gauge 1 Model Railway Association** *Newsletter & Journal* arrived, so it must be time for a cuppa. Bye! (Later) Well, that was fun. It began with Peter Jackmann writing on a 3D printed Deltic DP1 in blue with 'speed whiskers', as ran on BR in the 1950s. Interestingly, in order to avoid using sprung axles, he used compensated bogies in an attempt to keep the wheels in contact with the rails. These are based on the NASA-designed 'rocker' bogies in the Mars Rover currently making history on a planet far, far away… See Wikipedia. Malcolm High describes how to use Li-Ion cells. Geoff Clifford made a SR Pillbox guards van, so named for the newer, but smaller, and therefore more cramped, body fitted to an older design of chassis. Rob Lenicheck built a Denver & Rio Grande C-25. As he says, not often seen on UK metals, the coal-fired C-25 has a large firebox unencumbered by a trailing axle, a necessary consideration for coal firing in Gauge 1. Unusual, but definitely G1 material, whilst Ernie Noa suggests how to build travel boxes for international transport. A NE 1908 Railway Inspection Car makes a very different model. John Byson has 'Fun with a Fairlie', a complex, Roundhouse produced model. I also see a 66-page booklet on turbine locomotives, by Werner Jeggli, who has built four of them.

W. www.g1mra.com

And this picture from our cruise may remind visitors to Skegness of a certain railway poster by John Hassall in 1908 for the Great Northern Railway. 'Riga is SO bracing…' (**photo 5**).

And finally, my neighbour has been robbed! A frightening experience. The police were called and asked if he could identify his assailant. Yes, he said, it was that petrol pump there!

No ideas are left in this brain overnight…

CONTACT

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Epilogue: About Machines and their Creators

Mikhail Chernyshev offers a *paean* to the steam locomotive.

A locomotive is, next to a marine engine, the most sensitive thing man ever made.

Rudyard Kipling

There are things made for aesthetic and spiritual purposes; they have been created in all times. Their impact on the mankind's evolution is indisputable and their historical role is enormous. A lot has been said about them; they occupy their well-deserved places in museums and private collections. They adorn home interiors, building fronts and proudly raise their spires to the sky. I leave their description to art historians.

I want to talk here about objects that have a purely practical meaning which at the end of their service life are sent away to be melted down.

What makes us stop and wait for a locomotive appear from behind the hill and then stare at it as if enchanted? A steam locomotive built in difficult times without any decor and with a minimum of amenities. Black and smoky, that during its long life had to carry machines, coal, timber, homeless tramps and soldiers smelling of cordite.

A steam locomotive sports very few decorative panels and many have none at all; most of the principles laid down in it are visible to the eye and create a picture that is irresistibly expressive. The exterior of a steam locomotive obeying the strict laws of functionality slowly takes root in the human consciousness evolving along with it. A captivating sincerity allows the locomotive to fit into any landscape.

What makes children sneak into the scrap metal depot and rummage for hours through perplexing, exciting mechanisms, dismantle them and take home the parts they like particularly to store them as relics? One thing can be said with certainty: anyone who used to do it year after year in spite of the weather and banter of other people made his choice of a road once and for all.

The element of mechanics has captured me from childhood like a river and instead of doing my homework I spent time on the railway where station lights would fill my soul with yearning to see far-away places, and steam locomotives gathered at their home depot in the evening like elephants at a watering place, or at a giant scrap yard where sparks of human genius flicker among the rusty twisted metal.

When the workers and trucks go away, and the hoists turned off until the next morning make quiet sounds talking about the fatigue accumulated during the day, scrap metal begins to live its own life. Two turbojet engines – the mighty British Rolls-Royce and the swift German Humo – lie side by side reminiscent of the great battle of wits over the English Channel.

Agriculture, aviation and space, gigantism and miniaturization, forging presses and telephone exchanges, gyroscopes and compressors, design schools of the whole world are represented here, and like diamonds in the crown stand out precision metalworking machines. Their powerful cast-iron beds radiate healthy conservatism, and their strict, dull-shiny guides once gave rise to all this variety of forms scattered around.

Scrap metal forms mountains and valleys with the openwork structures of cranes and heavy hulks of cast-iron crushers towering above them.

Strolling among the fantastic combination of powerful machines I took in their purpose, learned to distinguish between design styles, noted successful technological solutions. There is a mystical charm of a giant junkyard which I will try to describe.

A combination of physical laws and technical ideas contained in any mechanism generates an elusive metaphysical meaning. One cannot feel it in a museum due to numerous annotations and a strict atmosphere where the operating mechanisms are inaccessible to subtle perception. It is only at a junkyard where the majestic machines are dismantled into pieces, where along with the smell of metal, electrical insulation and lubricants flows the spiritual energy of their creators you can feel you belong to the historical brotherhood of designers and workers.

In a huge semi-flooded quarry where the railway lines are overgrown with bushes, a home to hares, where grotesque toads jump into water and river gulls soaring in the air are whiter than chalk framing the sky-blue water is rusting a giant rotary excavator.

On a summer evening, I come to the edge of the cliff and gaze at the panorama of the quarry melting in a haze. The last sunset rays illuminate the ancient chalk layers, the water surface and the rust-covered giant. The partially opened veil of time leaves a vague, exciting call.

And when lavender twilight descends on the earth, seagulls pass the baton to bats, night flowers fill the air with their fragrance, and the boundaries of reality begin to blur and tremble I can see the rails going to that world where the best and most beautiful locomotive forever rushes through the night with the fire always burning in its furnace carrying all the lost letters to the addressees and the suffering souls to the place of eternal rest.

ME

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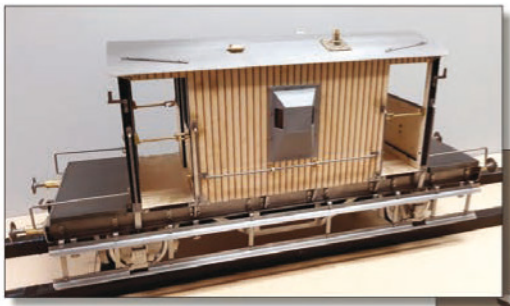

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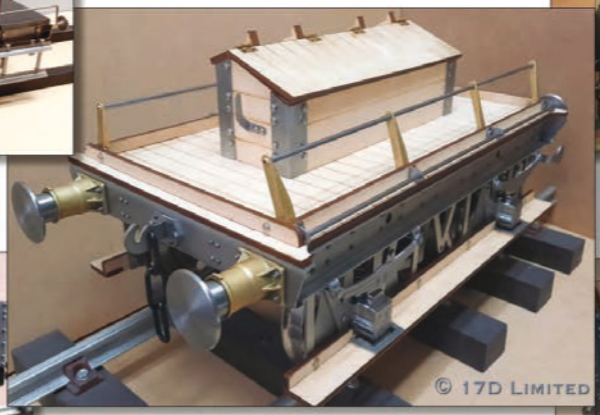

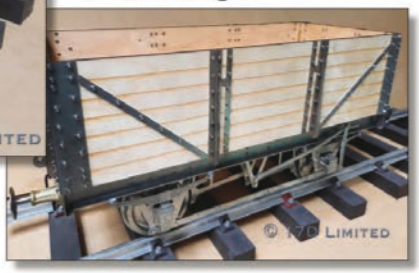

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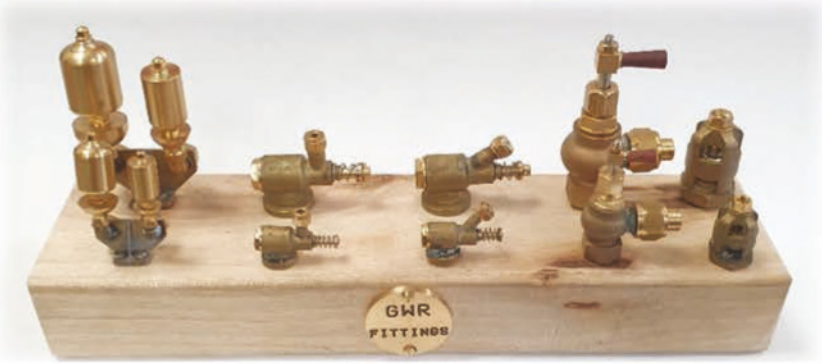

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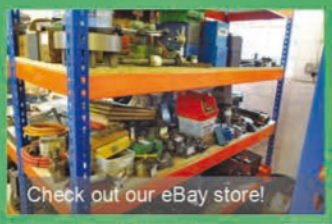
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Startrite Robland K210 £2450


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X-Y 12" x 6" table £525


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Harrison / Colchester change wheels


Pacific poss. 5" locomotive 4-6-2 Boiler kit, casting set and frames see website for more pictures £1800


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Clarke 917 vacuum former £495


Myford ER25 solid collet chuck made by Myford (Notts) New £70 More in our eBay shop! Big Bore £120


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Tripus 240v switch £90


Myford bridge & rifle felts £7.50 each


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Myford / Boxford / Colchester / Harrison change wheels available


Myford gearbox unused £1000


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Harrison M300 lathe £3950


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